ISO 9001:2015 AICTE-CII: GOLD Category Institute NAAC-'A' Grade Institute (CGPA: 3.21) NIRF-2020 Rank Band: 201-250

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
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# B.TECH. (ECI) CURRICULUM

## ACADEMIC YEAR: 2026–27

## DEPARTMENT OF ELECTRONICS COMMUNICATION AND INSTRUMENTATION ENGINEERING

Undergraduate Rules and Regulations (**URR24**)
**In accordance with the National Education Policy 2020**
**w.e.f. AY 2026-27**

**Regulations Governing the**
**Choice Based Credit System and**
**Multiple Entry and Multiple Exit Options**
**with**
**Competency-Focused Outcome Based Curriculum (CF-OBC)**

## DEPARTMENT OF ELECTRONICS COMMUNICATION AND INSTRUMENTATION ENGINEERING

*KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 506 015 TELANGANA*

***(UGC Autonomous Institute Under Kakatiya University, Warangal)***

## TABLE OF CONTENTS


| S. No. | Contents | Page No. |
|---|---|---|
| 1. | Institute Vision and Mission | 3 |
| 2. | Department Vision and Mission | 3 |
| 3. | Program Educational Objectives | 4 |
| 4. | Program Learning Outcomes | 5 |
| 5. | B. Tech (ECIE) – Scheme of Instructions | 7 |
| 6. | Undergraduate Rules and Regulations-2024 (URR24)<br>In accordance with the National Education Policy 2020 | 19 |
| 7. | Options for degree certificate | 20 |
| 8. | Semester wise course / credit distribution | 23 |
| 9. | Semester- I Syllabi | 25 |
| 10. | Semester – II Syllabi | 58 |
| 11. | Semester- III Syllabi | 100 |
| 12. | Semester – IV Syllabi | 131 |
| 13. | Semester- V Syllabi | 166 |
| 14. | Semester – VI Syllabi | 197 |
| 15. | Semester – VII Syllabi | 241 |
| 16. | Semester – VIII Syllabi | 285 |

## 1. INSTITUTE VISION AND MISSION

### *INSTITUTE VISION*

**To make our students technologically superior and ethically strong by providing quality education with the help of our dedicated faculty & staff and thus improve the quality of human life**

### INSTITUTE MISSION

| | |
|---|---|
| M1 | ■ **To provide latest technical knowledge, analytical & practical skills, managerial competence and interactive abilities to students, so that their employability is enhanced** |
| M2 | ■ **To provide strong human resource base to cater to the changing needs of the industry and commerce** |
| M3 | ■ **To inculcate a sense of brotherhood and National Integrity** |

## 2. DEPARTMENT OF ELECTRONICS COMMUNICATION AND INSTRUMENTATION ENGINEERING: VISION AND MISSION

### VISION

To achieve excellence in Electronics Communication and Instrumentation Engineering by imparting quality education to the students with a spirit of innovation & entrepreneurship aligned with the holistic & multidisciplinary approach and produce engineering graduates to serve industry and society

### MISSION

| | |
|---|---|
| M1: | To impart the required knowledge, skills and qualities to the students and make them industry ready to serve the society |
| M2: | To upgrade the pedagogical skills and resources for effective teaching-learning process with the help of dedicated faculty and staff |
| M3: | To create ambience that drives students towards innovation, research and entrepreneurship |
| M4: | To inculcate professional ethics and academic integrity among the students |

## 3. PROGRAM EDUCATIONAL OBJECTIVES

| | |
|---|---|
| **PEO1:** | **Technical Competence:** apply the knowledge of core courses of electronics communication and instrumentation engineering for development of effective and innovative solutions to engineering problems |
| **PEO2:** | **Successful Career:** excel in profession, higher education and entrepreneurship with updated technologies in communication, signal processing, VLSI, embedded systems, and instrumentation domains |
| **PEO3:** | **Soft Skills and Life-long Learning:** exhibit professional ethics, effective communication, and teamwork in solving engineering problems by adapting contemporary research towards sustainable development of society |

### PEOS TO MISSION MAPPING

| | M1 | M2 | M3 | M4 |
|---|---|---|---|---|
| **PEO1** | 3 | 3 | 2 | 2 |
| **PEO2** | 3 | 2 | 3 | 2 |
| **PEO3** | 2 | 3 | 3 | 2 |

| PEO Statements | Mission Statements | Mapping Level | Justification |
|---|---|---|---|
| **PEO1** | **M1** | **3** | Mapped strongly: The students will acquire required KSQs in the field of Electronics<br>Communication and Instrumentation engineering to become industry ready |
| | **M2** | **3** | Mapped strongly: The dedicated faculty and staff apply pedagogical skills and advanced resources to enable the students to develop effective and innovative solutions to engineering problems |
| | **M3** | **2** | Mapped moderately: The innovation, incubation, research and entrepreneurship (I2RE) facilities help the students in developing effective and innovative solutions to engineering problems |
| | **M4** | **2** | Mapped moderately: The students are imparted professional ethics and academic integrity |

| | | | |
|---|---|---|---|
| **PEO2** | **M1** | **3** | Mapped strongly: The students are imparted required knowledge, skills and qualities to excel in profession, higher education and entrepreneurship |
| | **M2** | **2** | Mapped moderately: The dedicated faculty and staff with upgraded pedagogical skills and resources help the students to excel in profession, higher education and entrepreneurship |
| | **M3** | **3** | Mapped strongly: The students are driven towards innovation, research and entrepreneurship through I2RE ambience |
| | **M4** | **2** | Mapped moderately: The students are imparted professional ethics and academic integrity |
| **PEO3** | **M1** | **2** | Mapped moderately: The students are imparted professional ethics, effective communication, and teamwork in solving engineering problems to make them industry ready and serve the society |
| | **M2** | **3** | Mapped strongly: The dedicated faculty and staff with upgraded pedagogical skills and resources help the students to solve engineering problems by adapting contemporary research for sustainable development of society |
| | **M3** | **3** | Mapped strongly: The I2RE facilities drive the students towards sustainable development of society through contemporary research |
| | **M4** | **2** | Mapped moderately: The students are imparted professional ethics and academic integrity towards sustainable development of society |

## 4. PROGRAM SPECIFIC OBJECTIVES

| | |
|---|---|
| **PSO1:** | Apply the fundamentals of Electronics, Communication Signal processing, VLSI, Embedded Systems and Instrumentation in development of hardware and software prototypes and systems for complex engineering problems |
| **PSO2:** | Apply appropriate methodology, contemporary hardware and software tools to solve complex engineering problems related to embedded systems |

## PO/PSO TO PEO MAPPING

| PO's | | PEO1 | PEO2 | PEO3 |
|---|---|---|---|---|
| **PO1** | Engineering Knowledge | 3 | 3 | 3 |
| **PO2** | Problem Analysis | 3 | 3 | 3 |
| **PO3** | Design/Development of solutions | 3 | 2 | 3 |
| **PO4** | Conduct investigations of complex problems | 3 | 2 | 3 |
| **PO5** | Engineering tool usage | 3 | 2 | 2 |
| **PO6** | The engineer and the world | 2 | 2 | 3 |
| **PO7** | Ethics | 3 | 3 | 3 |
| **PO8** | Individual and Teamwork | 3 | 3 | 3 |
| **PO9** | Communication | 2 | 2 | 3 |
| **PO10** | Project management and finance | 1 | 2 | 2 |
| **PO11** | Lifelong Learning | 3 | 3 | 3 |
| **PSO1** | Apply the fundamentals of Electronics, Communication Signal processing, VLSI, Embedded Systems and Instrumentation in development of hardware and software prototypes and systems for complex engineering problems | 3 | 3 | 2 |
| **PSO2** | Apply appropriate methodology, contemporary hardware and software tools to solve complex engineering problems related to embedded systems | 3 | 3 | 2 |

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# Scheme of Instructions

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| - | IKSC | U24IK100 | **AICTE Mandated Student Induction Programme (Universal Human Values - I)** | | | | | - |
| 1 | BSC | U24MH101 | Differential Calculus and Ordinary Differential Equations | 2 | 1 | - | 3 | 3 |
| 2 | BSC | U24PY102B | Engineering Physics *(for ECIE)* | 2 | 1 | 2 | 5 | 4 |
| 3 | PCC | U24CI103 | Electronic Measurements and Instrumentation | 2 | 1 | - | 3 | 3 |
| 4 | ESC | U24CI104 | Programming for Problem Solving with C | 2 | 1 | 2 | 5 | 4 |
| 5 | ESC | U24EE105B | Basic Electrical Engineering (*Common to ECE and ECIE*) | 2 | 1 | 2 | 5 | 4 |
| 6 | VAC | U24CY106 | Environmental Studies | 2 | - | - | 2 | - |
| 7 | AEC | U24AE107 | IDEA Lab Makerspace | - | - | 2 | 2 | 1 |
| 8 | ELC | U24EL108 | Practicum-1 | - | - | - | - | 1 |
| 9 | VAC | U24VA109XXXXX | SEA – I / SAA-1 | - | - | - | - | 1 |
| 10 | AEC | U24AE110 | Expert Talk Series-1 | - | - | - | - | 1 |
| | | | **Total:** | **12** | **5** | **8** | **25** | **22** |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

| **Pool – I (Physics)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24PY102A | Engineering Physics *(for CE)* |
| 2. | U24PY102B | Engineering Physics *(for ECIE)* |
| 3. | U24PY102C | Engineering Physics *(for CSE)* |
| 4. | U24PY102D | Engineering Physics *(for EEE)* |
| 5. | U24PY102E | Engineering Physics *(for ECE)* |

| **Pool – II (Basic Electrical & Electronics Engineering)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24EE105A | Basic Electrical and Electronics Engineering *(for CE)* |
| 2. | U24EE105B | Basic Electrical Engineering *(Common to ECE and ECIE)* |
| 3. | U24EE105C | Basic Electrical Engineering *(for CSE)* |
| 4. | U24EE105D | Basic Electrical Engineering *(for EEE)* |

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | BSC | U24MH201 | Matrix Theory and Vector Calculus | 2 | 1 | - | 3 | 3 |
| 2 | BSC | U24CY202B | Engineering Chemistry *(for ECIE)* | 2 | 1 | 2 | 5 | 4 |
| 3 | PCC | U24CI203 | Analog Electronics | 2 | 1 | - | 3 | 3 |
| 4 | ESC | U24CI204 | Data Structures through C | 2 | 1 | 2 | 5 | 4 |
| 5 | HSMC | U24MH205 | English Communication and Report Writing | 2 | - | - | 2 | 2 |
| 6 | VAC | U24VA206 | Sports and Yoga | - | - | 2 | 2 | 1 |
| 7 | ESC | U24ME207 | Engineering Graphics through CAD* | - | - | 2 | 2 | 1 |
| 8 | SEC | U24SE208 | Programming Skill Development (PSD) Laboratory- 1 | - | - | 2 | 2 | 1 |
| 9 | ELC | U24EL209 | Practicum-2 | - | - | - | - | 1 |
| 10 | VAC | U24VA210XXXX | SEA-2 / SAA -2 | - | - | - | - | 1 |
| 11 | AEC | U24AE211 | Expert Talk Series-2 | - | - | - | - | 1 |
| | | | **Total:** | **10** | **4** | **10** | **24** | **22** |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

| Pool – III (Chemistry) | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CY202A | Engineering Chemistry *(for CE)* |
| 2. | U24CY202B | Engineering Chemistry *(for ECIE)* |
| 3. | U24CY202C | Engineering Chemistry *(for CSE)* |
| 4. | U24CY202D | Engineering Chemistry *(for EEE)* |
| 5. | U24CY202E | Engineering Chemistry *(for ECE)* |

**Bridge Courses for exit:**

**Successful completion of two subjects (6-Credits) during 2-months internship at the institute**

**OR**

**Successful completion of two suitable skill based courses (external) to qualify for Certification**

**A. After First Year: (UG Certificate in ECI)**

**(i) The candidate should pass any two of the following additional courses (ITI Level) during the 2-Months internship at institute**

| Exit Options to Qualify for UG Certificate in ECI: Any Two (02) Courses during the 2 - Months internship | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **E** | **C** |
| **1** | **PCC** | **U24CI212X** | Digital Electronics | **2** | **-** | **2** | **4** | **3** |
| **2** | **PCC** | **U24CI213X** | Operational Amplifiers and Applications | **2** | **-** | **2** | **4** | **3** |
| **3** | **PCC** | **U24CI214X** | Communication Systems | **2** | **-** | **2** | **4** | **3** |
| **4** | **PCC** | **U24CI215X** | *Any other course approved by BoS Chair and Dean AA* | **2** | **-** | **2** | **4** | **3** |

**(OR)**

**(ii) Any two suitable skill based courses to qualify for Certification.**

| Exit Options to Qualify for UG Certificate in ECI: Any Two (02) Skill based Courses -: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **E** | **C** |
| **1** | **SEC** | **U24SE212XCI** | Consumer Electronics | **-** | **-** | **6** | **6** | **3** |
| **2** | **SEC** | **U24SE213XCI** | Radio Engineering | **-** | **-** | **6** | **6** | **3** |
| **3** | **SEC** | **U24SE214XCI** | Electronics Servicing and Maintenance | **-** | **-** | **6** | **6** | **3** |
| **4** | **SEC** | **U24SE215XCI** | Electronics & Hardware - Operation And Maintenance Of Respiratory Equipment STC-Operation_Maint_of_Resp_Eqpt_NSQF-3.pdf (nimilearningonline.in) | **-** | **-** | **6** | **6** | **3** |
| **5** | **SEC** | **U24SE216XCI** | Electronic Testing & Assembly Operator ntsc_hyd_detail_24082022_electronic.pdf (nsic.co.in) | **-** | **-** | **6** | **6** | **3** |
| **6** | **SEC** | **U24SE217XCI** | *Any other skill based course approved by BoS Chair and Dean AA* | **-** | **-** | **6** | **6** | **3** |

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | BSC | U24MH301C | Mathematical foundations for Signal Processing | 2 | 1 | - | 3 | 3 |
| 2 | PCC | U24CI302 | Sensors and Actuators | 2 | 1 | 2 | 5 | 4 |
| 3 | PCC | U24CI303 | Analog Integrated Circuits and Applications | 2 | 1 | 2 | 5 | 4 |
| 4 | PCC | U24CI304 | Digital Circuits and Logic Design | 2 | 1 | - | 3 | 3 |
| 5 | ESC | U24CI305 | OOP through Java | 2 | 1 | 2 | 5 | 4 |
| 6 | VAC | U24VA306A | Quantitative Aptitude and Logical Reasoning@ | 2 | | - | 2 | 2 |
| 7 | SEC | U24SE307 | Programming Skill Development Laboratory–2(DSC) | - | - | 2 | 2 | 1 |
| 8 | ELC | U24EL308 | Practicum-3 | - | - | - | - | 1 |
| 9 | VAC | U24VA309XXXXX | SEA-3 / SAA -3 | - | - | - | - | 1 |
| 10 | AEC | U24AE310 | Expert Talk Series-3 | - | - | - | - | 1 |
| | | | **Total:** | **12** | **5** | **8** | **25** | **24** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 29 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

| **Branch Specific Mathematics (Pool-4)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| **1.** | U24MH301A | Numerical and Statistical Methods *(for CE)* |
| **2.** | U24MH301B | Applied Mathematics *(for ME)* |
| **3.** | U24MH301C | Mathematical foundations for Signal Processing *(for ECI)* |
| **4.** | U24MH301D | Discrete Mathematics and Probability Statistics *(Common to CSE, CSN, CSO & IT)* |
| **5.** | U24MH301E | Essential Mathematics and Statistics for Machine learning *(for CSM)* |
| **6.** | U24MH301F | Essential Mathematics and Statistics for Data science *(for CSD)* |

| **@U24VA306 T & P Basket** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| **1.** | U24VA306A | Quantitative Aptitude and Logical Reasoning *(for Stream I)* |
| **2.** | U24VA306B | Soft and Interpersonal Skills Lab *(for Stream II)* |

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | PCC | U24CI401 | VLSI Design | 2 | 1 | - | 3 | 3 |
| 2 | PCC | U24CI402 | Digital Signal Processing | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI403 | Electromagnetic Theory and Wave Propagation | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI404 | Computer Architecture and Microprocessors | 2 | 1 | - | 3 | 3 |
| 5 | ESC | U24CI405 | Python Programming | 2 | 1 | - | 3 | 3 |
| 6 | VAC | U24VA406B | Soft and Interpersonal Skills Laboratory | - | - | 2 | 2 | 1 |
| 7 | SEC | U24SE407 | Programming Skill Development Laboratory – 3 (Java) | - | - | 2 | 2 | 1 |
| 8 | PCC | U24CI408 | VLSI Design Laboratory | - | - | 2 | 2 | 1 |
| 9 | PCC | U24CI409 | Digital Signal Processing Laboratory | - | - | 2 | 2 | 1 |
| 10 | PCC | U24CI410 | Python Programming Laboratory | - | - | 2 | 2 | 1 |
| 11 | VAC* | U24CY411* | Environmental Studies* | 2* | - | - | 2* | - |
| **Total:** | | | | **12** | **5** | **10** | **25/ 27*** | **20** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 25 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

**For Lateral Entry Students Only*

| @U24VA406 T & P Basket | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| **1.** | U24VA406A | Quantitative Aptitude and Logical Reasoning *(for Stream II)* |
| **2.** | U24VA406B | Soft and Interpersonal Skills Lab *(for Stream I)* |

**Bridge Courses for exit:**

**Successful completion of two subjects (6-Credits) during 2-months internship at the institute**

**OR**

**Successful completion of two suitable skill based courses (external) to qualify for Certification**

**B. After Second Year: (UG Diploma in ECI)**

**(i) The candidate should pass any two of the following additional courses (Diploma Level) during the 2-Months internship at institute**

| Exit Options to Qualify for UG Diploma in ECI: Any Two (02) Courses during the 2 - Months internship | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **E** | **C** |
| **1** | **PCC** | **U24CI412X** | Introduction to Microcontrollers and Embedded Systems | **2** | **-** | **2** | **4** | **3** |
| **2** | **PCC** | **U24CI413X** | Fundamentals of Internet of Things | **2** | **-** | **2** | **4** | **3** |
| **3** | **PCC** | **U24CI414X** | Printed Circuit Board Design | **2** | **-** | **2** | **4** | **3** |
| **4** | **PCC** | **U24CI415X** | *Any other course approved by BoS Chair and Dean AA* | **2** | **-** | **2** | **4** | **3** |

**(OR)**

**(ii) Any two suitable skill based courses to qualify for Diploma**

| Exit Options to Qualify for UG Diploma in ECI: Any Two (02) Skill based Courses -: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **E** | **C** |
| **1** | **SEC** | **U24SE412XCI** | Data Communication and Networking | **-** | **-** | **6** | **6** | **3** |
| **2** | **SEC** | **U24SE413XCI** | Electronics Servicing and Maintenance | **-** | **-** | **6** | **6** | **3** |
| **3** | **SEC** | **U24SE414XCI** | Advanced PCB Designing ntsc_hyd_detail_24082022_electronic.pdf (nsic.co.in) | **-** | **-** | **6** | **6** | **3** |
| **4** | **SEC** | **U24SE415XCI** | Android APP Development Microsoft Word - 5. SOFWARE I2022-23_ENG_HINDI (nsic.co.in) | **-** | **-** | **6** | **6** | **3** |
| **5** | **SEC** | **U24SE416XCI** | *Any other skill based course approved by BoS Chair and Dean AA* | **-** | **-** | **6** | **6** | **3** |

**B. Tech Honours with Research:**

***Students opting for B. Tech Honours with Research shall undergo a 2-Month Mandatory Research Internship-I (5 Credits) at respective department during the summer vacation after IV Semester.***

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | OE | U24OE501X | Open Elective – Startup & Entrepreneurship Basket (OE-S&EB) | 2 | 1 | - | 3 | 3 |
| 2 | PCC | U24CI502 | Internet of Things | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI503 | Microcontrollers and Embedded Systems | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI504 | Artificial Intelligence and Machine Learning | 2 | 1 | - | 3 | 3 |
| 5 | ESC | U24CI505 | Linear Control Systems | 2 | 1 | - | 3 | 3 |
| 6 | IKSC | U24IK506A | Essence of Indian Traditional Knowledge | 2 | - | - | 2 | 2 |
| 7 | HSMC | U24MH507 | Technical English | - | - | 2 | 2 | 1 |
| 8 | PCC | U24CI508 | Microcontrollers and Embedded Systems Laboratory | - | - | 2 | 2 | 1 |
| 9 | PCC | U24CI509 | AIML Applications Laboratory | - | - | 2 | 2 | 1 |
| 10 | ELC | U24CI510 | Seminar | - | - | 2 | 2 | 1 |
| **Total:** | | | | **12** | **5** | **8** | **25** | **21** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 26 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

| Open Elective - Startup & Entrepreneurship Basket (OE-S&EB) | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24OE501A | Design Thinking |
| 2. | U24OE501B | Innovative Product Design and Development |
| 3. | U24OE501C | Entrepreneurship |
| 4. | U24OE501D | Design Studio |
| 5. | U24OE501E | *Any other course approved by BoS Chair and Dean AA* |

## URR24 VI SEMESTER

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | OE | U24OE601Y | Open Elective – Management Basket (OE-MB) | 2 | 1 | - | 3 | 3 |
| 2 | PEC | U24CI602X | Program Elective –I / MOOCs-I | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI603 | Embedded Systems with ARM Processor | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI604 | Analog and Digital Communications | 2 | 1 | - | 3 | 3 |
| 5 | PCC | U24CI605 | System Verilog for Verification | 2 | 1 | - | 3 | 3 |
| 6 | IKSC | U24IK606B | Universal Human Values - II | 2 | - | - | 2 | 2 |
| 7 | PCC | U24CI607 | Internet of Things Laboratory | - | - | 2 | 2 | 1 |
| 8 | PCC | U24CI608 | Analog and Digital Communications Laboratory | - | - | 2 | 2 | 1 |
| 9 | PCC | U24CI609 | Embedded Systems with ARM Processor Laboratory | - | - | 2 | 2 | 1 |
| 10 | ELC | U24CI610 | Mini Project | - | - | 2 | 2 | 1 |
| **Total:** | | | | **12** | **5** | **8** | **25** | **21** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 26 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

*@List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula*

***B. Tech Honours with Research**: Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-II (5 Credits) at respective department during the summer vacation after VI Semester.*

| **Open Elective – Management Basket (OE-MB)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24OE601A | Management Economics and Accountancy |
| 2. | U24OE601B | Engineering Finance |
| 3. | U24OE601C | Organizational Behaviour |
| 4. | U24OE601D | E-Commerce and Digital Marketing |
| 5. | U24OE601E | *Any other course approved by BoS Chair and Dean AA* |
| **Program Elective – I Basket / MOOCs-I** | | |
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI602A | Introduction to Operating Systems |
| 2. | U24CI602B | Cloud Computing |
| 3. | U24CI602C | Introduction to FPGA design |
| 4. | U24CI602D | Advanced Signal Processing |
| 5. | U24CI602E | *Any other course approved by BoS Chair and Dean AA* |

**Bridge Courses for exit:**

**Successful completion of two subjects (6-Credits) during 2-months internship at the institute**

**OR**

**Successful completion of two suitable skill based courses (external) to qualify for Certification**

## C. After Third Year: (B. Voc. in ECI)

**(i) The candidate should pass any two of the following additional courses (Degree Level) during the 2-Months internship at institute**

| Exit Option to Qualify for B. Voc in ECI: Any Two (02) Courses during the 2 - Months internship | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **E** | **C** |
| **1** | **PCC** | **U24CI610X** | FPGA Architectures | **2** | **-** | **2** | **4** | **3** |
| **2** | **PCC** | **U24CI611X** | Process Control | **2** | **-** | **2** | **4** | **3** |
| **3** | **PCC** | **U24CI612X** | Optical Fiber Communication | **2** | **-** | **2** | **4** | **3** |
| **4** | **PCC** | **U24CI613X** | *Any other course approved by BoS Chair and Dean AA* | **2** | **-** | **2** | **4** | **3** |

**(OR)**

**(ii) Any two suitable skill based courses to qualify for B. Voc in ECI Degree.**

| Exit Option to Qualify for B. Voc in ECI: Any Two (02) Skill based Courses -: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **E** | **C** |
| **1** | **SEC** | **U24SE610XCI** | **Advanced Mobile Communication** | **-** | **-** | **6** | **6** | **3** |
| **2** | **SEC** | **U24SE611XCI** | **Cyber Security** Microsoft Word - 5. SOFWARE I 2022-23_ENG_HINDI (nsic.co.in) | **-** | **-** | **6** | **6** | **3** |
| **3** | **SEC** | **U24SE612XCI** | **PLC PROGRAMMER** ntsc_hyd_hindi_24082022_electrical.pdf (nsic.co.in) | **-** | **-** | **6** | **6** | **3** |
| **4** | **SEC** | **U24SE613XCI** | *Any other skill based course approved by BoS Chair and Dean AA* | **-** | **-** | **6** | **6** | **3** |

***(Note to HoDs on PCC: Under PCC the departments shall plan appropriate courses up to 6th semester covering GATE syllabus).***

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | OE | U24OE701 | Open Elective – Sustainable Development Goals Basket (OE-SDGB) | 2 | 1 | - | 3 | 3 |
| 2 | PEC | U24CI702 | Program Elective - II/ MOOCs-II | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI703 | Industrial Automation and Control | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI704 | Biomedical Instrumentation | 2 | 1 | - | 3 | 3 |
| 5 | PCC | U24CI705 | Digital Image Processing and Computer Vision | 2 | 1 | - | 3 | 3 |
| 6 | PCC | U24CI706 | Industrial Automation and Control Laboratory | - | - | 2 | 2 | 1 |
| 7 | PCC | U24CI707 | System Verilog for Verification Laboratory | - | - | 2 | 2 | 1 |
| 8 | ELC | U24CI708 | Internship Evaluation* | - | - | 2 | 2 | 1 |
| 9 | ELC | U24CI709 | Major Project, Phase-1 / Industrial Internship - 1 | - | - | 8 | 8 | 4 |
| **Total:** | | | | **10** | **5** | **14** | **29** | **22** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 4 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 26 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

*@ List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula*

***B. Tech Honours with Research:*** *Students opting for B. Tech Honours with Research, shall complete Research Methodology Course (4 Credits) through MOOCS (OR) a workshop / FDP of not less than one week on "Research Methodologies" (4 Credits).*

*Internship Evaluation for the students opting B. Tech Honours with Research, will be done on the 2-Month Research internship-II.*

| **Open Elective – Sustainable Development Goals Basket (OE-SDGB)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24OE701A | Sustainable Waste Management and Circular Economy (*offered by CED*) |
| 2. | U24OE701Y | Automotive Engineering for Sustainable Development (*offered by MED*) |
| 3. | U24OE701E | Renewable Energy Systems (*offered by EEED*) |
| 4. | U24OE701I | AI Ethics (*offered by CSMD*) |
| **Program Elective – II Basket / MOOCs-II** | | |
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI702A | RTOS for Embedded Systems |
| 2. | U24CI702B | Industrial Internet of Things |
| 3. | U24CI702C | VLSI Physical Design |
| 4. | U24CI702D | Wireless and Mobile Communications |
| 5. | U24CI702E | *Any other course approved by BoS Chair and Dean AA* |

## URR24 VIII SEMESTER

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | PEC | U24CI801X | Program Elective - III / MOOCs-IV | 2 | 1 | - | 3 | 3 |
| 2 | PEC | U24CI802X | Program Elective - IV / MOOCs-V | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI803 | Satellite and Fiber Optic Communication | 2 | 1 | - | 3 | 3 |
| 4 | ELC | U24CI804 | Major Project, Phase – 2 / Industrial Internship - 2 | - | - | 12 | 12 | 6 |
| **Total:** | | | | **6** | **3** | **12** | **21** | **15** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 4 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 19 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

*@ List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula*

***B. Tech Honours with Research**: Students opting for B. Tech Honours with Research, shall Publish a research paper in reputed journal indexed by SCI / SCOPUS/Web of Science (4 Credits).*

| **Program Elective – III Basket / MOOCs-III** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI801A | Embedded Linux Systems |
| 2. | U24CI801B | Cybersecurity |
| 3. | U24CI801C | Low power VLSI design |
| 4. | U24CI801D | Biomedical Signal Processing |
| 5. | U24CI801E | *Any other course approved by BoS Chair and Dean AA* |
| **Program Elective – IV Basket / MOOCs-IV** | | |
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI802A | Mechatronics |
| 2. | U24CI802B | Deep Learning |
| 3. | U24CI802C | Static Timing Analysis |
| 4. | U24CI802D | 5G and beyond Communications |
| 5. | U24CI802E | *Any other course approved by BoS Chair and Dean AA* |

## URR24 SUMMARY

| SEMESTER | I | II | III | IV | V | VI | VII | VIII | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| CREDITS | 22 | 22 | 24 | 20 | 21 | 21 | 22 | 15 | 167 |

## 6. Undergraduate Rules and Regulations-2024 (URR24)
## (In accordance with the National Education Policy 2020)

### 6.1 MULTIPLE EXIT OPTIONS

| Sl. No. | Exit Description | Exit Point | Degree/Certificate offered | Goal |
|---|---|---|---|---|
| **1.** | First Exit | After completion of First year. | UG Certificate in ECI | The student should be employable as Technical Assistant (ECI) in any industry/organization. |
| **2.** | Second Exit | After completion of Second year. | UG Diploma in ECI | The student should be employable as Technician (ECI) in any industry /organization. |
| **3.** | Third Exit | After completion of Third year. | B. Voc in ECI | The student should be employable as Technical Supervisor (ECI) in any industry/organization. |
| **4.** | Normal Exit | After completion of Fourth year. | B.Tech in ECI | The student should be employable as an Engineer (ECI) in any relevant industry/organization. |

### 6.2 MULTIPLE ENTRY OPTIONS

| Sl. No. | Entry Descriptions | Entry Point | Eligibility |
|---|---|---|---|
| **1.** | Normal (First) Entry | I-Sem of the program | As per the TGCHE guidelines & through Common Entrance Examination TSEAPCET |
| **2.** | Second Entry | III-Sem of the program | The successful completion of first year with UG certificate in ECIE from our institute. |
| **3.** | Third Entry | V-Sem of the program | The successful completion of UG Diploma in ECIE from our institute. |
| **4.** | Fourth Entry | VII-Sem of the program | The successful completion of B. Voc in ECIE from our institute. |

**(i)** **No. of maximum exits:** as per NEP2020/UGC/AICTE guidelines on MEME
**(ii)** **No. of maximum entry:** as per NEP2020/UGC/AICTE guidelines on MEME
**(iii)** **Maximum gap between exit and entry:** as per NEP2020/UGC/AICTE guidelines on MEME
**(iv)** **Academic Bank of Credits shall be maintained**

## 7. OPTIONS FOR DEGREE CERTIFICATE

(i) Learners who earn a minimum of total 172 credits will be **awarded** ***"B.Tech" degree which confirms to NEP2020 requirements of multidisciplinary holistic education.***

(ii) Fast Learners have the following options to earn ***B. Tech degree with Honours / Minor.***

**a)** ***B.Tech with "Minor" degree (with additional 18 credits): 172+18 Credits***

Students opting for Minor degree offered by other departments / in identified cutting-edge technologies /external recognized organizations, can start the programme in either 3rd semester or in 5th semester as per their interest. The requirement for completion of Minor degree programme is that the students are,

(i) **3rd to 6th semesters**: allowed to take maximum one theory and one lab course in each semester, starting from 3rd to 6th semesters

(ii) **7th & 8th semesters**: allowed to take only one theory course per semester in 7th and 8th semesters

Students should complete 4 theory and two lab courses by the end of 8th semester. However, All four theory courses have to be completed through MOOCS and lab courses have to be completed in the department which offers the Minor degree programme.

**b)** ***B.Tech with "Honours" degree (with additional 18 credits): 172+18 Credits***

Students opting for Honours degree offered by their own department / external recognized organizations, can start in either 3rd or 5th semester as per their interest. The requirement for completion of Minor degree programme is that the students are,

(i) **3rd to 6th semesters**: allowed to take maximum one theory and one lab course in each semester, starting from 3rd to 6th semesters

(ii) **7th & 8th semesters**: allowed to take only one theory course per semester in 7th and 8th semesters

Students should complete 4 theory and two lab courses by the end of 8th semester. However, All four theory courses have to be completed through MOOCS and lab courses have to be completed in the department which offers the Minor degree programme.

***c) B.Tech – "Honours with Research" degree (with additional 18 credits by research ): 172+18 credits***

Students opting for Honours with Research degree, can start in 4th semester. They are expected to complete one course on "Research Methodology" through MOOCS or can complete one week FDP on "Research Methodology" during 4th semester (4 credits). They have to complete two research internships each of 2-month duration, one in summer after 2nd year (5 credits) and other in summer after 3rd year (5 credits). They have to work on **individual research based project**, starting from 5th semester onwards. They have to present a Seminar on the individual research project in 5th semester, carryout a Mini-Project during 6th semester and

continue the same as Major Project during 7th & 8th semesters. Finally, publish a research paper as outcome of their research project, in a journal indexed by SCI/SCOPUS/WEB OF SCIENCE (4 credits), by the end of 8th semester. ***(The individual research project itself shall be considered for regular B. Tech degree programme under Seminar, Mini-Project and Major Project work courses)***

**7.1 Summary of requirements for earning additional credits leading to "Minor", "Honours" and "Honours with Research" degrees:**

| Semester | B. Tech with "Minor" | B. Tech with "Honours" | B. Tech "Honours with Research" |
|---|---|---|---|
| I | - | - | - |
| II | - | - | - |
| III | 1 theory (4 credits) + 1 lab (1 credit) | 1 theory (4 credits) + 1 lab (1 credit) | - |
| IV | 1 theory (4 credits) + 1 lab (1 credit) | 1 theory (4 credits) + 1 lab (1 credit) | "Research Methodology" Theory Course (4 Credits) |
| Summer break after 2nd year | - | - | 2-Months Research Internship -I (5 credits) |
| V | 1 theory (4 credits) + 1 lab (1 credit) | 1 theory (4 credits) + 1 lab (1 credit) | - |
| VI | 1 theory (4 credits) + 1 lab (1 credit) | 1 theory (4 credits) + 1 lab (1 credit) | - |
| Summer break after 3rd year | - | - | 2-Months Research Internship -II (5 credits) |
| VII | 1 theory (4 credits) | 1 theory (4 credits) | |
| VIII | 1 theory (4 credits) | 1 theory (4 credits) | One research publication in Journal indexed by SCI / SCOPUS / Web of Science (4 Credits) |
| **Total additional credits to be earned** | **Overall 18 credits (through 4 theory and 2 lab courses)** | **Overall 18 credits (through 4 theory and 2 lab courses)** | **18 credits (through Research Methodology, 2 Research Internships and a Research Publication out of Individual Research Project)** |

**7.2 Credit requirements for four different options of the B. Tech Degree**

| | I | II | III | IV | V | VI | VII | VIII | Total |
|---|---|---|---|---|---|---|---|---|---|
| **B. Tech** | **22** | **22** | **24** | **20** | **21** | **21** | **22** | **15** | **167** |
| **B. Tech with Minor** | **22** | **22** | **24** | **20** | **21** | **21** | **22** | **15** | 167 (+18)* |
| **B. Tech with Honours** | **22** | **22** | **24** | **20** | **21** | **21** | **22** | **15** | 167 (+18)* |
| **B. Tech. Honours with Research** | **22** | **22** | **24** | **20** | **21** | **21** | **22** | **15** | 167 (+18)* |

**Optional additional Credits leading to Minor/Honours/Honours with Research as applicable*

### 7.3 Options for earning of "Additional Points" for Honours certification

<table>
<tr><th>S. No.</th><th>Activity</th><th>Points earned</th><th>Maximum Limit</th></tr>
<tr><td>1</td><td>Success in the GATE Exam</td><td><table><tr><th>Percentile</th><th>Points</th></tr><tr><td>Above 98</td><td>8</td></tr><tr><td>Above 95</td><td>6</td></tr><tr><td>Above 90</td><td>4</td></tr><tr><td>Qualified</td><td>2</td></tr></table></td><td>8 Points</td></tr>
<tr><td>2</td><td>Research Publication indexed by SCI / SCOPUS / Web of Science*</td><td>SCI Journal: 8 Points<br>SCOPUS / Web of Science Journal: 4 Points<br>Patent: 4 Points</td><td>8 Points</td></tr>
<tr><td>3</td><td>Winning Prestigious Technical Competition at National Level#</td><td><table><tr><th>Rank</th><th>Points</th></tr><tr><td>1</td><td>4</td></tr><tr><td>2</td><td>3</td></tr><tr><td>3</td><td>2</td></tr></table></td><td>6 Points</td></tr>
<tr><td>4</td><td>Completion of PG level MOOCS</td><td><table><tr><th>Percentile</th><th>Points</th></tr><tr><td>Above 95</td><td>6</td></tr><tr><td>Above 90</td><td>5</td></tr><tr><td>Above 80</td><td>4</td></tr></table></td><td>6 Points</td></tr>
<tr><td></td><td colspan="2">Total Points Restricted to a maximum of</td><td>8 Points</td></tr>
</table>

**Note:**

*As the activities mentioned in the above Table of 11.3 are aimed at an additional professional dimension to the professional personality of the learners, each Point earned is given 1 credit equivalency. Thus, Honours registered students are allowed to accumulate a maximum of 8 additional Points through these activities, equivalent to two courses (8 credits) of Honours curriculum requirement.*

***In journals only. Journal to be approved by the BoS chair and Dean AA***

***#In events approved by the BoS chair and Dean AA***

## 8.1 SUMMARY OF CURRICULUM COMPONENTS

| S.NO. | CATEGORY | COURSE COMPONENT | TOTAL COURSES | TOTAL CREDITS | CURRICULUM CONTENT (%OF CREDITS) |
|---|---|---|---|---|---|
| **1** | HSMC | Humanity, Social Sciences and Management Courses | 2 | 3 | 1.80 |
| **2** | BSC | Basic Science Courses | 5 | 17 | 10.18 |
| **3** | ESC | Engineering Science Courses | 7 | 23 | 13.77 |
| **4** | PCC | Program Core Courses | 29 | 69 | 41.32 |
| **5** | PEC | Program Elective Courses | 4 | 12 | 7.19 |
| **6** | MOPEC | Multidisciplinary Open Elective Courses | 3 | 9 | 5.39 |
| **7** | ELC | Experiential Learning Courses | 8 | 16 | 9.58 |
| **8** | IKSC | Indian Knowledge System Courses | 3 | 4 | 2.40 |
| **9** | VAC | Value Added Courses | 8 | 7 | 4.19 |
| **10** | SEC | Skill Enhancement Courses | 3 | 3 | 1.80 |
| **11** | AEC | Ability Enhancement Courses | 4 | 4 | 2.40 |
| | | **Total** | **76** | **167** | **100.00** |

## 8.2 SEMESTER WISE COURSE / CREDIT DISTRIBUTION

| Semester | Number of Courses / Number of Credits (*Course Category wise*) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BSC** | **ESC** | **HSMC** | **PCC** | **OE** | **PEC** | **SEC** | **VAC** | **ELC** | **AEC** | **IKSC** | **TOTAL** |
| I | 2/7 | 2/8 | | 1/3 | | | | 2/1 | 1/1 | 2/2 | 1/0 | **11/22** |
| II | 2/7 | 2/5 | 1/2 | 1/3 | | | 1/1 | 2/2 | 1/1 | 1/1 | | **11/22** |
| III | 1/3 | 1/4 | | 3/11 | | | 1/1 | 2/3 | 1/1 | 1/1 | | **10/24** |
| IV | | 1/3 | | 7/15 | | | 1/1 | 2/1 | | | | **11/20** |
| V | | 1/3 | 1/1 | 5/11 | 1/3 | | | | 1/1 | | 1/2 | **10/21** |
| VI | | | | 6/12 | 1/3 | 1/3 | | | 1/1 | | 1/2 | **10/21** |
| VII | | | | 5/11 | 1/3 | 1/3 | | | 2/5 | | | **9/22** |
| VIII | | | | 1/3 | | 2/6 | | | 1/6 | | | **4/15** |
| Total | **5/17** | **7/23** | **2/3** | **29/69** | **3/9** | **4/12** | **3/3** | **8/7** | **8/16** | **4/4** | **3/4** | **76/167** |
| % Weightage of Course Category | 10.18 % (17/167) | 13.77 % (23/167) | 1.80 % (3/167) | 41.32 % (69/167) | 5.39 % (9/167) | 7.19 % (12/167) | 1.80 % (3/167) | 4.19 % (7/167) | 9.58 % (16/167) | 2.40 % (4/167) | 2.40 % (4/167) | **100 % (167/167)** |

ISO 9001:2015 AICTE-CII: GOLD Category Institute NAAC-'A' Grade Institute (CGPA: 3.21) NIRF-2020 Rank Band: 201-250

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

# Semester -I Syllabi

**URR24 - I SEMESTER**

**Stream – I**

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | O | E | C |
| - | IKSC | U24IK100 | AICTE Mandated Student Induction Programme (Universal Human Values - I) | | | | | | - |
| 1 | BSC | U24MH101 | Differential Calculus and Ordinary Differential Equations | 2 | 1 | - | 6 | 9 | 3 |
| 2 | BSC | U24PY102B | Engineering Physics *(for ECIE)* | 2 | 1 | 2 | 5 | 10 | 4 |
| 3 | PCC | U24CI103 | Electronic Measurements and Instrumentation | 2 | 1 | - | 4 | 7 | 3 |
| 4 | ESC | U24CI104 | Programming for Problem Solving with C | 2 | 1 | 2 | 5 | 10 | 4 |
| 5 | ESC | U24EE105B | Basic Electrical Engineering (*Common to ECE and ECIE*) | 2 | 1 | 2 | 5 | 10 | 4 |
| 6 | VAC | U24CY106 | Environmental Studies | 2 | - | - | 3 | 5 | - |
| 7 | AEC | U24AE107 | IDEA Lab Makerspace | - | - | 2 | 2 | 4 | 1 |
| 8 | ELC | U24EL108 | Practicum-1 | - | - | - | 4 | 4 | 1 |
| 9 | VAC | U24VA109 | SEA – I / SAA-1 | - | - | - | 2 | 2 | 1 |
| 10 | AEC | U24AE110 | Expert Talk Series-1 | - | - | - | 1 | 1 | 1 |
| | | | **Total:** | **12** | **5** | **8** | **37** | **62** | **22** |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **-** | **-** | **-** | **-** | **-** | **-** |

# DIFFERENTIAL CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I -Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24MH101** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-1-0-6-9** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** convergence of an infinite series and differential calculus

**LO2:** partial differentiation and its applications

**LO3**: differential equations of first order and first degree along with certain applications

**LO4:** higher order linear differential equations and applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Infinite Series:** Sequences, Series, General properties of series, Series of positive terms, Comparison tests-Limit form, Integral test, D'Alembert's Ratio test, Cauchy's root test

**Differential Calculus and its applications:** Fundamental theorems-Rolle's theorem (Geometrical interpretation), Lagrange's mean value theorem (Geometrical interpretation), Cauchy's mean value theorem, Taylor's theorem (Generalized mean value theorem), Expansions of functions- Maclaurin's series, Taylor's series, Maxima and Minima-Conditions, Practical problems (rectangle, right circular cylinder, cone)

***Self-Learning Topics (SLTs):*** *Review of basic concepts of limit, continuity and differentiability [Reference 1: topic (3.1,3.2,3.5,4.1)]*

*Alternating series [(Text 1: topic 9.12, Solved problems: 9.16,9.17, Practice problems: exercise 9.7(1, 7)]*

*Additional problems on fundamental theorems [(Text 1: topic 4.3, Solved problems: 4.13(i),4.14,4.17, Practice problems: exercise 4.4 (1(i),1(ii), 3(ii), 10(i), 10(ii))]*

*Additional problems on Maclaurin's series [(Text 1: topic 4.4, Solved problems: 4.20, Practice problems: exercise 4.5 (3, 5)]*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Partial differentiation and its applications:** Functions of two or more variables, Partial derivatives, Total derivative, Change of variables, Jacobians, Functional relationship, Geometrical Interpretation-Tangent plane and Normal to a surface, Taylor's theorem for function of two variables (without proof), Errors and approximations, Total differential, Maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers, Differentiation under the integral sign

***Self-Learning Topics (SLTs):***

*Leibnitz rule of Differentiation under the integral sign for variable limits [(Text 1: topic 5.13(2)), Solved problems: 5.54, Practice problems: exercise 5.11 (1)]*

*Additional problems on maxima and minima of function of two variables [(Text 1: topic 5.11 (1), Solved problems: 5.42, 5.43, Practice problems: exercise 5.10 (1(i),1(ii),1(iii))].*

*Additional problems on Lagrange's methods of undetermined multipliers [(Text 1: topic (5.12), Solved problems: 5.45, 5.48, Practice problems: exercise 5.10 (3(i) ,3(ii))]*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Differential equations of first order (DE):** Reorientation of differential equation of first order and first degree (Formation a differential equation, variables separable method, homogeneous equations, Linear equations), Exact differential equations, Equations reducible to exact equations,

**Applications of differential equations of first order:** Orthogonal trajectories - Orthogonal trajectories of the family of curves f(x, y, c)=0, Physical applications-Motion of a boat across a stream, Resisted motion, Velocity of escape from the earth, Simple electric circuits - RL series circuit, Newton's law of cooling, Rate of decay of Radio-active materials, Rate of growth of population

***Self-Learning Topics (SLTs):*** *Review of DEs of first order (Text 1: topic 11.1, 11.2, 11.3, 11.4,11.5)*
*Solutions of Non-exact DEs by Inspection Method [(Text 1: topic 11.12(1), Solved Problems: 11.30, Practice problems: exercise 11.8 (1,3)]*
*Additional problems on Non-exact DEs [(Text 1: topic 11.12(2,3,4,5), Solved problems: 11.33,11.35,11.36, Practice problems: exercise 11.8 (9,15)]*
*Orthogonal Trajectories of family of curves in polar coordinates [(Text 1: topic 12.3(3), Solved problems :12.7,12.8 , Practice problems: exercise 12.2(9,10)]*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Linear differential equations:** Linear differential equations with constant coefficients, Rules for finding complementary function, Inverse operator, Rules for finding the particular integral ($Q=e^{ax}$, sin(ax+b) or cos(ax+b), $x^m$ and $e^{ax}V(x)$), Method of variation of parameters, Linear dependence of solutions

**Applications of linear differential equations**: Simple harmonic motion, Simple pendulum, Oscillations of spring, Oscillatory electrical circuit-LCR circuit, Electro-mechanical analog

***Self-Learning Topics (SLTs):***
*Finding the particular integral of* $Q(X) = X^m V(X)$ *[(Text 1: topic 13.7, Solved problems: 13.16,13.17,13.19, Practice problems: exercise 13.2 (21,22)].*
*Additional problems on method of variation of parameters [(Text 1: topic 13.8(1), Solved problems: 13.25, 13.26, Practice problems: exercise 13.3(1,5)]*
*Cauchy's homogeneous linear differential equation [(Text 1: topic 13.9(1), Solved problems: 13.31,13.34, Practice problems: exercise 13.4(3,6,9)]*

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: examine the convergence of a series and interpret mean value theorems.
**CO2**: apply partial differentiation to functions of several variables in solving various engineering problems.
**CO3**: apply appropriate methods of differential equations of first order and first degree to solve real life engineering problems.
**CO4**: analyze the solutions of higher order linear differential equation with constant coefficients

**Textbook(s):**

1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, Delhi, 44th edition, 2017

**Reference Book(s):**

1. Shanti Narayan, Dr. Mittal P.K, *Differential Calculus*, S. Chand & Co., New Delhi, 1st edition, Reprint 2014
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, U.K, John wiely & sons, 10th edition, 2020
3. S.S. Sastry, *Engineering Mathematics, Vol.II,* Prentice Hall of India, 3rd edition, 2014.

**Web and Video link(s):**

1. https://youtu.be/4EYko9rdF7g?si=WUu12 *NPTEL Video Lecture on Infinite series by Prof. S.K.Ray, Professor of Mathematics, IITK Kanpur.*
2. https://youtu.be/0apMXhWG_W8?si=M-abw2Gq3buX5HLM *NPTEL Video Lecture on Fundamental mean value theorems by Prof. Jithedra Kumar, Professor of Mathematics, IITK Kharagpur.*
3. https://youtu.be/6r5jfT8xrXM?si=ryLXYVJr4-iUkdlV; *NPTEL Video Lecture on Exact Differential Equations, Prof. Jithedra Kumar, Professor of Mathematics, IIT Kharagpur.*
4. https://youtu.be/kbGhrqV9AOM?si=yGyK_V7kJKGa3OaR *NPTEL Video Lecture on Orthogonal Trajectories of family of curves by Prof. Aditya Sharma, Professor of Physics, IISE Bhopal.*
5. *https://youtu.be/btOCUmJkrrg?si=zq3nB00kplm7b5se; NPTEL Video Lecture on Higher Order Linear Differential Equations, Prof. Jithedra Kumar, Professor of Mathematics, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24MH101 DIFFERENTIAL CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24MH101.1** | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **CO2** | **U24MH101.2** | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **CO3** | **U24MH101.3** | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **CO4** | **U24MH101.4** | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **U24MH101** | | **2** | **2** | **1** | **1** | **-** | **-** | **-** | **1** | **1** | **-** | **1** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

| **ENGINEERING PHYSICS** (*for ECIE)* | | | |
|---|---|---|---|
| **Class:** B.Tech. I- Semester | | **Branch:** ECIE | |
| **Course Code:** | **U24PY102B** | **Credits:** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** lasers, fiber optics and their applications in various emerging fields
**LO2:** electricity, magnetism and dielectric & magnetic materials
**LO3:** semiconductor physics and semiconductor diodes
**LO4:** rectifiers, filters and bipolar junction transistors (BJTs)

**THEORY COMPONENT**

| **UNIT-I** | **9 Hrs** |
|---|---|

**Applied Optics and Lasers:** Principles of interference, Diffraction phenomena and applications (qualitative); Difference between conventional light and laser, Basic principles and characteristics of lasers, Absorption, Spontaneous and stimulated emission, Population inversion, Pumping methods, Optical resonator; Types of lasers- Ruby laser, He-Ne laser, Diode laser; Applications of lasers

**Fiber Optics:** Introduction, Total internal reflection, Optical fiber construction, Numerical aperture and acceptance angle; Types of optical fibers - Step index and graded index, Single and multimode, V-number; Power losses in optical fibers - Attenuation, Dispersion, Bending; Fiber optic communication system, Applications of optical fibers – Endoscopy, Fiber optic sensors (temperature and displacement)

***Self Learning Topics (SLTs):*** *Concept of wave and basic concepts- amplitude, wavelength, frequency, phase, phase angle and general wave equation (Text1: topic 1.9), types of waves(Text1: topic 1.10), reflection laws(Text1: topic 1.11).*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Electricity and Magnetism:** Basic laws of electricity and magnetism, Electric displacement, Maxwell's equations

**Dielectric and Magnetic materials:** Dielectrics, Dielectric constant, Dielectric polarization, Types of polarization, Dielectric breakdown; Magnetic materials- Permeability, Magnetization, Susceptibility, Origin of magnetism, Bohr magneton, Ferro, Antiferro and ferri magnetic materials, Hysteresis, Soft and hard magnetic materials and applications

***Self Learning Topics (SLTs):*** *polarization (Text3: topic 5.3), properties of dielectric (Text3: topic 5.6), eddy currents(Text3: topic 6.5).*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Semiconductor Physics:** Classification of solids based on energy band theory- Conductors, Semiconductors and Insulators, Intrinsic semiconductors- Carrier generation and recombination, Intrinsic conductivity; Extrinsic semiconductors- p-type and n-type (qualitative), Extrinsic conductivity, Variation of Fermi energy level with temperature and impurity concentration, Drift and diffusion currents; Hall effect (qualitative)

**Semiconductor Diodes:** Formation of a PN junction, Forward and reverse bias, PN junction diode, Diode current equation, V-I characteristics, Zener diode, Zener diode as voltage regulator, Light emitting diode (LED) and applications, Photodiode and applications

***Self Learning Topics (SLTs):*** *drift and diffusion current (Text2: topic 4.9), diode current equation (Text2: topic 4.15), Solved problems (Text2: Prob 4.17 to 4.21)*

| UNIT-IV | 9 Hrs |
|---|---|

**Rectifiers:** Types of rectifiers- Half-wave rectifier, Full-wave rectifier, Ripple factor, Filters- L, C, LC(L-section) and CLC ($\pi$ - section)

**Bipolar Junction Transistors (BJTs):** Transistor structure, Representation of NPN and PNP transistors, Transistor operation, Transistor configurations - Common base(CB), Common emitter(CE) and Common collector(CC); $\alpha$, $\beta$, $\gamma$ parameters and their relations
**Phototransistor**: Operation and applications

***Self Learning Topics (SLTs):*** *Solved problems (Text2: Prob18.1 to 18.3), transistor as amplifier (Text2: topics 6.7), Solved problems (Text2: Prob 6.1 to 6.5)*

**LABORATORY COMPONENT**

**List of Experiments**

1. Linear Measurements using Vernier callipers and screw gauge
2. Determination of slit width using He-Ne laser
3. Determination of wavelength of He-Ne laser using reflection and transmission diffraction grating
4. Numerical aperture and acceptance angle of an optical fiber
5. Determination of dielectric constant of materials using parallel plate capacitor
6. Magnetic hysteresis- B-H curve tracing using CRO
7. Study of V-I characteristics of PN junction diode
8. Study of V-I characteristics of LED
9. Study of characteristics of half-wave and full-wave rectifier
10. Study of common emitter characteristics of NPN transistor
11. Study of energy band gap of a semiconductor material
12. Determination of Hall coefficient, carrier density of given semiconducting material using Hall effect setup

**Textbook(s):**


1. M. Avadhanulu and Kshirsagar, TVS Arun Murthy, A Text Book of Engineering Physics, S. Chand & Company Ltd, 11th edition, 2018
2. S Salivahanan, N Suresh Kumar, Electronic devices and circuits, Mc Graw Hill, 3rd edition, 2017
3. K.B.Raina, S.K.Bhattacharya, T. Joneja, Electrical Engineering Materials and Electronic Components, S.K.Kataria & Sons Publisher, 2005


**Reference Book(s):**


1. Bhattacharya and Bhaskaran, *Engineering Physics*, Oxford University Press, 1st edition, 2013
2. V. Rajendran, *EngineeringPhysics*, Mc Graw Hill, 2013
3. R.K. Gaur and S.L.Gupta, *Engineering Physics*, Dhanpath Rai and Sons publications, 2013
4. David Halliday, Robert Resnick & S Krane, *Physics Volume I&II*, Wiley India Limited, 5th edition, 2014


**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc24_ph28/preview, *NPTEL video lecture on Concepts in Magnetism and Superconductivity by Prof. Arghya Taraphder IIT Kharagpur*
2. https://onlinecourses.nptel.ac.in/noc24_lw07/preview, *NPTEL video lecture on Introduction to Law on Electricity by Prof. Uday Shankar, IIT Kharagpur*
3. https://onlinecourses.nptel.ac.in/noc24_ph45/preview, *NPTEL video lecture on Introduction to LASER by Prof. M. R. Shenoy, IIT Delhi*

4. https://onlinecourses.nptel.ac.in/noc24_ee143/preview, *NPTEL video lecture on Semiconductor Devices and Circuits by Prof. Sanjiv Sambandan, IISc Bangalore*

**Laboratory Manual (for laboratory component):**

1. *Engineering Physics Laboratory Manual & Record Book,* Department of PS, KITSW
2. A.K.Katiyar, C.K.Pandey, *Engineering Physics Theory and Practical,* Wiley India Pvt. Ltd, 2nd edition, 2017

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1**: evaluate properties of lasers and optical fibre parameters

**CO2:** determine static electric field and magnetic field using Maxwell's equations; determine the properties of dielectric and magnetic materials

**CO3:** analyze V-I characteristics of semiconductor diodes

**CO4:** calculate ripple factor & efficiency of diode rectifier circuits and analyze transistor input /output characteristics

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: measure diameter of wire and hollow tubes using Vernier callipers and screw gauge

**CO6:** determine the width of a narrow slit and wavelength of laser using diffraction phenomenon and numerical aperture of an optical fiber

**CO7:** determine the dielectric constant of a material and plot the hysteresis curve of ferromagnetic material

**CO8:** determine forward voltage and currents from V-I characteristics of semiconductor diodes, identify cut-off, saturation and active regions of NPN transistor

| **Course Articulation Matrix (CAM):** | | **U24PY102B ENGINEERING PHYSICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24PY102B.1** | 2 | 1 | 1 | - | - | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO2** | **U24PY102B.2** | 2 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO3** | **U24PY102B.3** | 2 | 1 | - | - | - | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO4** | **U24PY102B.4** | 2 | 1 | - | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO5** | **U24PY102B.5** | 2 | 1 | 1 | - | 1 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 |
| **CO6** | **U24PY102B.6** | 2 | 1 | - | - | 1 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 |
| **CO7** | **U24PY102B.7** | 2 | 1 | - | - | 1 | 1 | 1 | 1 | 2 | - | 1 | 1 | 1 |
| **CO8** | **U24PY102B.8** | 2 | 1 | - | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| **U24PY102B** | | **2** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1.5** | **1** | **1** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I -Semester | | **Branch:** ECIE | |
| **Course Code: U24CI103** | **U24CI103** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-1-0-4-7** | **CIE :** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE :** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** measurement system, electromechanical instruments and their applications
**LO2:** electronic instruments, DC & AC bridge circuits and their applications
**LO3:** working principle of resistive, inductive transducers and their applications
**LO4:** sensing principle of capacitive, piezoelectric & thermoelectric transducers and their applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Measurement System**: Introduction, Significance, Standards of measurement, Generalized block diagram, Examples, Static characteristics, Dynamic response, Types of errors

**Electromechanical Instruments (*Principle of operation*)**: PMMC mechanism, DC ammeter, Multi range ammeter, DC voltmeter, Multi range voltmeter, Ohmmeter, Rectifier type Instrument

***Self Learning Topics (SLTs):*** *Standards of Measurement (Text1:topic 1.3), Problems on Errors (Text1:topic 1.12)*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Electronic Instruments (*Block diagram approach*):** Introduction and advantages, Digital multimeter (DMM) - Resolution & accuracy of 3½ & 4½ DMM; Q-meter principle, Oscilloscopes – Working principle of cathode ray tube (CRT), Cathode ray oscilloscope (CRO), Deflection sensitivity, Digital storage oscilloscope (DSO), CRO measurements

**DC & AC Bridges:** Wheatstone bridge, Maxwell bridge, Schering bridge, Wien's bridge, Applications of bridges

***Self Learning Topics (SLTs):*** *Dual trace oscilloscope (Text1:topic 2.5.13), Kelvin bridge (Text1:topic 2.6.4)*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Sensors and Transducers (*Principle of operation*):** Introduction, Classification, ideal requirements

**Resistance transducers:** Potentiometer, Strain gauge (SG) - gauge factor, classification, full bridge SG configuration, Applications of SG (force, torque), Rosette, RTD, Thermistor

**Inductive transducers:** Electromagnetic type, Variable reluctance type, LVDT, Applications of LVDT (displacement, pressure)

***Self Learning Topics (SLTs):*** *Electro dynamic type transducer (Text1:topic 7.7.1.2), Electromagnetic frequency domain transducer (Text1:topic 7.21.2)*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Capacitive transducers:** Variable gap, Variable area & variable dielectric type, Differential type capacitive transducer, Applications of capacitive transducers (sound, level)

**Piezoelectric transducers:** Piezoelectric phenomenon, Piezoelectric materials, Sensitivity constants, Modes of operation (LE, TE & VE), Bimorphs, Applications of piezoelectric transducers (stress, acceleration)

**Thermoelectric transducers:** Thermoelectric effects, Thermocouple materials and types,

Thermoelectric laws, Thermopile

***Self Learning Topics (SLTs):*** *Thermocouple cold junction compensation circuit (Text1:topic 12.2.5.4, example 12.3), Optical pyrometers (Text1: topics 12.2.7)*

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: develop measurement system based on application requirements and utilize electromechanical instruments for current, voltage & resistance measurement

**CO2**: measure amplitude, frequency, phase & quality factor using electronic instruments

**CO3**: classify transducers and select appropriate resistive & inductive transducers to measure physical parameters

**CO4**: recommend suitable transducer to measure sound, level, stress, acceleration & temperature

**Textbook(s):**

1. R.K. Rajput, *Electronic Measurements and Instrumentation,* S. Chand & Co., New Delhi 3rd edition, 2020

**Reference Book(s):**

1. Helfrick. A.D and Cooper W.D., *Modern Electronic Instrumentation and Measurement Techniques*, Pearson India Education, New Delhi, 2nd edition, 2016
2. B. C. Nakra and K. K. Chaudhry, *Instrumentation Measurement and Analysis,* Tata Mc Graw-Hill Education pvt. Ltd., New Delhi, 4th edition, 2016
3. A.K. Sawhney, *A course in Electrical and Electronics Measurements and Instrumentation*, Dhanpatrai & Co., New Delhi, 2020
4. P. Pruthviraj, B. Bhudaditya, S. Das and K. Chiranjib, *Electrical and Electronic Measurement and Instrumentation*, McGraw-Hill Education, New Delhi, 2nd edition, 2013

**Web and Video link(s):**

1. https://archive.nptel.ac.in/courses/108/105/108105153/; *NPTEL Video Lecture on Electrical Measurements and Electronic instruments, by Prof. Avishekh Chatarjee, Professor of Electrical Engineering, IITK Kharagpur.*
2. https://archive.nptel.ac.in/courses/108/108/108108147/; *NPTEL Video Lecture on Sensors and Actuators by Assistant professor, Department of Electronic Systems Engineering, IISC Bangalore.*

| **Course Articulation Matrix (CAM):** | | **U24CI103 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI103.1** | 2 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 2 | - |
| **CO2** | **U24CI103.2** | 2 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 2 | - |
| **CO3** | **U24CI103.3** | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO4** | **U24CI103.4** | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **U24CI103** | | **2** | **1** | **1** | **1** | 1 | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PROGRAMMING FOR PROBLEM SOLVING WITH C

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I -Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24CI104** | **Credits:** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1**: algorithms, flow charts and develop programs with basic constructs

**LO2:** control structures and array operations

**LO3:** string operations and modular programming concepts with functions and recursion

**LO4:** structures, unions, pointers and files in C programming

**THEORY COMPONENT**

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Programming:** Art of programming through algorithms and flowcharts

**Overview of C:** History of C, Importance of C, Basic structure of C programs

**Constants, Variables and Data Types:** Character set, C tokens, Declaration of variables, Defining symbolic constants

**Managing Input and Output Operations:** Reading a character, Writing a character**,** Formatted input, Formatted output

**Operators and Expressions:** Arithmetic, Relational, Increment, Decrement, Conditional, Logical, Bit-wise, Special operators, Arithmetic expressions, Evaluation of expressions, Operator precedence and associativity

***Self Learning Topics (SLTs):*** *Components of a computer, concept of hardware and software (Text1: chapter 1), Executing a C program (Text1: chapter 2), Type conversions in expression (Text1: chapter 4) Solved problems (Text1: chapter 2 to chapter 5), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 2 to chapter 5)*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Decision Making and Branching:** Simple if statement, if-else statement, Nesting of if-else statements, else if ladder, switch statement, Conditional operator, goto statement

**Decision Making and Looping:** while statement, do-while statement, for statement, Nested loops, Jumps in loops

**Arrays:** One-dimensional arrays, Declaration of one-dimensional arrays, Initialization of one-dimensional arrays, Linear search, Two-dimensional arrays, Initializing two dimensional arrays, Multi-dimensional arrays

***Self Learning Topics (SLTs):*** *Concise test expressions (Text1: chapter 7) Dynamic arrays (Text1: chapter 8), Solved problems (Text1: chapter 6 to chapter 8), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 6 to chapter 8)*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Character Arrays and Strings:** Declaring and initializing string variable, Reading strings from terminal, Writing strings to screen, String handling functions, Table of strings

**Modular Programming with User Defined Functions:** Need for user-defined functions, Elements of user-defined functions, Definition of functions, Return values and their types, Function calls, Function declaration, Category of functions, Recursion, The scope, visibility and lifetime of variables (storage classes)

***Self Learning Topics (SLTs):*** *Arithmetic operations on characters, comparison of strings (Text1: chapter 9), Nesting of functions, (Text1: chapter 10), Solved problems (Text1: chapter 9 & chapter 10), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 9 & chapter 10).*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Structures and Unions:** Defining a structure, Declaring and initializing structure variables, Accessing structure members, Array of structures, Structures within structures, Unions

**Pointers:** Understanding pointers, Declaring and initializing pointer variables, Pointer expressions, Pointers and arrays, Pointers and character strings, Pointers to functions, Pointers and structures

**File Management in C:** Defining and opening a file, Closing a file, Input and output operations on sequential text files

***Self Learning Topics (SLTs):*** *Operations on individual members (Text1: chapter 11), Chain of pointers, array of pointers (Text1: chapter 12), Random access to files, Command line arguments (Text1: chapter 13). Solved problems (Text1: chapter 11 to chapter 13), Review questions, debugging exercises, programming exercises, interview questions (Text1: chapter 11 to chapter 13).*

**LABORATORY COMPONENT**

**List of Experiments**

1. Programs using input output functions, operators (arithmetic, relational and conditional)
2. Programs using operators (bit-wise, logical, increment and decrement)
3. Programs using conditional control structures: if, if-else, nested if
4. Programs using else if ladder, switch and goto statements
5. Programs using loop control structures: while
6. Programs using loop control structures: do-while and for
7. Programs on one dimensional array and two-dimensional arrays
8. Programs on String operations and string handling functions
9. Programs on different types of functions, parameter passing using call-by-value & call-by-address, recursion and storage classes
10. Programs using structures, unions, pointers to arrays and pointers to strings
11. Programs using array of pointers and pointers to structures
12. Programs on File operations and file handling functions for sequential text files

**Textbook(s):**

1. Balagurusamy. E, *Programming in ANSI C*, McGraw Hill, 8th edition, 2022

**Reference Book(s):**

1. Paul Deitel, Harvey Deitel, *C How to Program: With Case Studies Introducing Applications Programming and Systems Programming*, Pearson Education Limited, 9th edition, 2022
2. Brian W. Kernighan and Dennis Ritchie, *The C Programming Language*, Pearson Education India, 2nd edition, 2015
3. Reema Thareja, *Programming in C,* Oxford University Press, 3rd edition, 2023
4. Yashavant Kanetkar, *Let Us C,* BPB Publications, 19th edition, 2022
5. A. K. Sharma, *Computer Fundamentals and Programming in C,* Universities Press, 2nd edition, 2018

**Web and Video link(s):**

https://nptel.ac.in/courses/106105171 *NPTEL Video Lecture on Problem Solving through*

*Programming in C by Prof. Anupam Basu, Professor of CSE, IIT Kharagpur.*

https://nptel.ac.in/courses/106104128 *NPTEL Video Lecture on Introduction to Programming in C by Prof. Satyadev Nandakumar, Professor of CSE, IIT Kanpur*

**Laboratory Manual (for laboratory component):**

1. *Programming for Problem Solving with C Laboratory Manual and Record Book,* Department of CSE, KITSW.

## Course Learning Outcomes (COs):

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1**: enumerate programming development steps, design an algorithm and draw a flow chart for a given application

**CO2**: apply logical skills for problem solving using control structures and arrays

**CO3**: develop string operations and modular programming with functions

**CO4**: analyse and implement structures, unions, pointers and files in C programming

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: develop programs using operators and decision making statements

**CO6**: apply loops and arrays to develop a program of an application

**CO7**: implement string operations and develop modular programs using user-defined functions, recursion, & storage classes.

**CO8**: develop programs using structures, unions, pointers and files

| Course Articulation Matrix (CAM): | | U24CI104: PROGRAMMING FOR PROBLEM SOLVING WITH C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CI104.1 | 2 | 1 | 1 | 1 | - | - | 1 | - | 1 | - | 2 | 1 | 2 |
| CO2 | U24CI104.2 | 2 | 2 | 2 | 1 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| CO3 | U24CI104.3 | 2 | 2 | 3 | 1 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| CO4 | U24CI104.4 | 2 | 2 | 3 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| CO5 | U24CI104.5 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 2 | 1 | 2 |
| CO6 | U24CI104.6 | 1 | 2 | 2 | 2 | 1 | - | 1 | 1 | 1 | - | 2 | 2 | 2 |
| CO7 | U24CI104.7 | 1 | 2 | 3 | 2 | 1 | - | 1 | 1 | 1 | - | 2 | 2 | 2 |
| CO8 | U24CI104.8 | 1 | 2 | 3 | 2 | 1 | - | 1 | 1 | 1 | - | 2 | 2 | 2 |
| U24CI104 | | 1.5 | 1.75 | 2.25 | 1.5 | 1 | - | 1 | 1 | 1 | - | 2 | 1.75 | 2 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# BASIC ELECTRICAL ENGINEERING

*(Common to ECE & ECIE)*

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I -Semester | | **Branch:** Common to ECE & ECIE | |
| **Course Code:** | **U24EE105B** | **Credits** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE** | **60 %** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1**: network elements and DC circuits
**LO2**: DC network theorems
**LO3**: 1- Ø AC circuits, 3-Ø AC circuits, and series resonance
**LO4**: construction, principles, and applications of DC & AC machines, concepts of earthing, fuses, and MCB

**THEORY COMPONENT**

| **UNIT-I** | **9 Hrs** |
|---|---|

**DC circuits:** Network elements, Linear & non-linear elements, Active & passive elements, Unilateral & bilateral elements, Ohm's law, Power, Energy, Kirchhoff's laws, Resistances connected in series and parallel, Voltage divider rule & Current divider rule.

**DC circuit analysis:** Source transformation, Star-Delta conversion, Mesh analysis & Nodal analysis. (T & π networks only).

***Self-Learning Topics (SLTs)**: Definitions of charge, current, & voltage (Text1: Topics1.2), Solved problems (Text1: Prob 3.10, 3.11 & 3.12), Practice problems (Text1: Chap-3, Prob 4,5,7&8).*

| **UNIT-II** | **9 Hrs** |
|---|---|

**DC network theorems (Independent sources only): S**uperposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem & Reciprocity theorem. (T and π networks only).

***Self-Learning Topics (SLTs):** Condition for maximum power transfer (Text1: Topics3.9), Solved problems (Text1: Prob 3.15, 3.18, 3.23 & 3.25), Practice problems (Text1: Chap-3,Prob 9,10,13 & 14).*

| **UNIT-III** | **9 Hrs** |
|---|---|

1-Ø **AC circuits:** R.M.S value, Average value, Peak factor and form factor of a sine wave, Concept of phasor, Phase and Phase difference, Rectangular and Polar form representation, Sinusoidal steady state analysis of R, L, C, Series RL, RC, RLC circuits, Parallel RL, RC & RLC circuits, Concept of reactance, Impedance, Susceptance, Admittance, Complex power, Real power, Reactive power and Power factor & Series Resonance.

**3- Ø AC circuits:** Generation of 3- Ø voltages, Advantages, Disadvantages, Applications of a three-phase system, Voltage & Current relationships of line and phase values for balanced star and delta connections.

***Self-Learning Topics (SLTs):** Expression for RMS & Average value (Text1: Topic, 4.4 & 4.5) Solved problems (Text1: Prob 4.10, 4.12, 4.13 & 4.14), Practice problems (Text1:Chap-4, Prob 8,9,12&12).*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Electrical machines & Electrical Earthing (Qualitative treatment):**

**Electrical Machines:** Construction, Principle of operation, Characteristics & applications of 1- Ø transformer, 1- Ø induction motor, DC motor, Stepper motor and BLDC motor.

**Electrical earthing, Fuses:** Basic concepts of electric shock, Earthing, Fuses, Miniature Circuit Breaker (MCB)

***Self-Learning Topics (SLTs):** EMF equation of a Transformer (Text1: Part-II Topic, 4.4.2) Solved*

*problems (Text1: Part-II Prob 4.5, 4.6 & 4.7), Practice problems (Text1: Part-II Prob 5.2, 5.3 & 5.4), Practice problems (Text1: Part-II Prob 6, 7 & 8)*

**LABORATORY COMPONENT**

**List of Experiments**

1. Verification of voltage divider rule and current divider rule
2. Verification of Mesh Analysis
3. Verification of Nodal Analysis
4. Verification of Superposition Theorem
5. Verification of Thevenin's Theorem
6. Verification of Maximum power transfer Theorem
7. Determination of internal parameters of a choke coil
8. Impedance calculations and phasor representation of RL series circuit
9. Impedance calculations and phasor representation of RC series circuit
10. Load test on 1-phase transformer
11. Verification of Kirchoff's laws using PSPICE/MATLAB
12. **Interfacing Sensors with Arduino using TINKER CAD**
    i. LED blinking
    ii. IR Sensor
    iii. Ultrasonic Sensor
    iv. Voltage Sensor
    v. Current Sensor
    vi. Speed Sensor

**Textbook(s):**

1. K. Uma Rao, *Basic Electrical Engineering* , Pearson Education, edition,2011

**Reference Book(s):**

1. B.L.Thereja, A.K.Thereja, Electrical Technology Vol. I & II , S.Chand & Company Ltd, edition , 2005
2. Edward Hughes, Electrical & Electronics Technology , Pearson Education, 10th edition, 2010
3. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering , Tata McGraw Hill, edition, 2010
4. Chakravarthy A, Sudhipanath and Chandan Kumar, Basic Electrical Engineering, Tata McGraw Hill Ltd, 4th edition, 2013

**Web and Video link(s):**

https://nptel.ac.in/courses/108/105/108105112//; *NPTEL Video Lecture on Fundamentals of Electrical Engineering by Prof. Debapriya Das, Professor of EED, IITK Kharagpur.*

**Laboratory Manual (for laboratory component):**

1. *Basic Electrical Engineering Laboratory Manual and Record Book,* Department of EEE, KITSW

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from the theory component)*

**CO1**: determine voltage, current & power in electrical circuits using network reduction techniques, mesh & nodal analysis

**CO2**: apply suitable network theorems to analyze DC circuits

**CO3**: determine impedance, voltage, current, power in 1- Ø & 3- Ø AC circuits and bandwidth & quality factor of series resonant circuit

**CO4**: select a suitable electrical machine for a given application and analyze the essential roles of electrical earthing, fuses, and MCBs in electrical systems

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: validate mesh and nodal analysis

**CO6**: validate network theorems

**CO7**: determine the impedance of series RL & RC circuits at various operating frequencies

**CO8**: determine the efficiency of a transformer using load test and verify Kirchhoff's laws using PSPICE

| **Course Articulation Matrix (CAM):** | | **U24EE105B : BASIC ELECTRICAL ENGINEERING** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24EE105B.1** | 2 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO2** | **U24EE105B.2** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO3** | **U24EE105B.3** | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO4** | **U24EE105B.4** | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO5** | **U24EE105B.5** | 2 | 1 | - | - | - | - | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO6** | **U24EE105B.6** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO7** | **U24EE105B.7** | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **CO8** | **U24EE105B.8** | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **1** | 2 | 1 |
| **U24EE105B** | | **2.5** | **2.25** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# ENVIRONMENTAL STUDIES

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I Semester | | **Branch:** Common to CE, EEE, ECIE, ECE & CSE | |
| **Course Code:** | **U24CY106** | **Credits:** | **0** |
| **Hours/Week (L-T-P-O-E):** | **2-0-0-3-5** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** natural resources and their usage more equitably
**LO2:** ecosystem and the importance of biodiversity conservation
**LO3:** environmental pollution and it's control measures
**LO4:** environmental legislation and green methodology

| **UNIT-I** | **6 Hrs** |
|---|---|

**The Multidisciplinary Nature of Environmental Studies**: Definition, Scope and importance
**Natural Resources:** Forest Resources-Use and over exploitation of forests, Deforestation, Timber extraction, Mining, Dams and their effects on forests and tribal people**;** Water Resources-Use and over-utilization of surface and ground water, Floods, Drought, Conflicts over water**;** Mineral Resources-Environmental effects of extracting and using mineral resources**;** Energy Resources-Renewable and non-renewable energy sources, Use of alternate energy sources
***Self Learning Topics (SLTs):*** *Use and over-utilization of surface and ground water (Text1: unit 2, topic: 2.2.2) world food problems (Text1: unit 2, topic 2.2.2)*

| **UNIT-II** | **6 Hrs** |
|---|---|

**Ecosystem and Biodiversity:**
**Ecosystem:** Concepts of an ecosystem, Food chain, Food webs, Ecological pyramids, Energy flow in the ecosystem and ecological succession
**Biodiversity and its Conservation:** Introduction, Definition, Genetic, Species and ecosystem diversity, Value of biodiversity, Biodiversity in India, Hot spots of biodiversity, Man-wildlife conflicts, Endangered and endemic species of India; In-situ and Ex-situ conservation
***Self Learning Topics (SLTs):*** *Introduction and definition of biodiversity (Text1: unit 4, topic 4.1)*

| **UNIT-III** | **6 Hrs** |
|---|---|

**Environmental Pollution:** Global issues**-**Global climatic change, Greenhouse gases, Effects of global warming, Ozone layer depletion
**International Conventions/Protocols:** Earth summit, Kyoto protocol, Montreal protocol
**Environmental Pollution-**Causes and effects of air, Water, Soil, Marine and noise pollution with case studies
**Solid and Hazardous Waste Management:** Introduction, Types, Effects of urban industrial and nuclear waste
**Natural Disaster Management:** Introduction to disaster, Management of disaster, Disaster management of flood, earthquake, cyclone and landslides
Role of information technology in environment and human health
***Self Learning Topics (SLTs):*** *Role of individual in prevention of pollution (Text1: unit 5, topic 5.10)*

| UNIT-IV | 6 Hrs |
|---|---|

**Social Issues and the Environment:** Role of Individual and Society, Water conservation, Rain water harvesting

**Environmental Protection/Control Acts:** Air (prevention and control of pollution) act 1981, Forest conservation act (1980 and 1992), Wildlife protection act 1972, Environment protection act 1986, Issues involved in enforcement of environmental legislations

**Green Methodology:** Principles of green chemistry, Green methods in electronic production, Impact of electronic waste on public health and environment; United nations goals of sustainable development

***Self Learning Topics (SLTs):*** *Water (prevention and control of pollution) act 1974 (Text1: unit 6, topics 6.10), Water pollution cess act 1977 (Text1: unit 6, topics 6.11)*

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1:** identify the natural resources and practice their usage more equitably

**CO2:** develop an action plan for sustainable alternatives and conserving biodiversity

**CO3:** examine and perceive the solutions for the environmental pollution

**CO4:** adapt issues involved in enforcement of environmental legislation and green methodology

**Textbook(s):**

1. Erach Bharucha, *Text Book of Environmental Studies for Under Graduate Courses,* 2nd edition., Universities Press (India) Pvt. Ltd, *2013*

**Reference Book(s):**

1. Y. Anjaneyulu, *Introduction to Environmental Science*, B.S. Publications, 2004.
2. Gilbert M. Masters, *Introduction to Environmental Engineering & Science*, 3rd edition., Prentice Hall of India,1991
3. Anubha Kaushik, C.P. Kaushik, *Environmental Studies*, 4th Edn., New Age International Publishers,2014
4. R. Rajagopalan, *Environmental Studies from crisis to cure*, Oxford University Press, 2nd edition, 2011

**Web and Video link(s):**

1. https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-ch27/ *video lecture on renewable energy resources by Prof. Vaibhav. V. Goud and Dr. R. Anandalakshmi, Dept. Of Chemical Engineering, Guwahati.*

| Course Articulation Matrix (CAM): | | U24CY106 ENVIRONMENTAL STUDIES | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CY106.1 | 2 | 1 | 2 | 1 | - | 2 | 1 | 1 | 1 | - | - | 1 | 1 |
| CO2 | U24CY106.2 | - | - | 2 | - | - | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 |
| CO3 | U24CY106.3 | 1 | 2 | 1 | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| CO4 | U24CY106.4 | - | - | 1 | - | - | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| U24CY106 | | **1.5** | **1.5** | **1.5** | **1** | **-** | **1.25** | **1** | **1** | **1** | **1** | **1** | **1** | **1** |

3 – HIGH, 2 – MEDIUM, 1 - LOW

# IDEA Lab Makerspace

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24AE107** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-2-2-4** | **CIE :** | **60 %** |
| **Total Number of Lab Hours:** | **24 Hrs** | **ESE :** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1**: carpentry and CNC wood router
**LO2**: mould for sand casting and arc welding joints
**LO3**: laser engraving, 3D printing and robots in manufacturing
**LO4**: Printed Circuit Board (PCB) and Internet of Things (IoT)

**LABORATORY COMPONENT**

| S. No. | Creative Fabrication Technology | List of Experiments |
|---|---|---|
| **1.** | Carpentry | Prepare a half lap dovetail joint |
| **2.** | CNC Wood Router | Perform wood carving using CNC Wood Router |
| **3.** | Foundry | Prepare a sand mould using single piece pattern |
| **4.** | Welding | Prepare a single V-butt joint on mild steel plates using AC arc welding machine |
| **5.** | Injection Moulding | Prepare a plastic product using Injection moulding machine |
| **6.** | Laser Engraving | Perform key chain by using $CO_2$ laser cutting machine |
| **7.** | 3D Printing | Prepare a key chain on 3D printer with the given dimensions |
| **8.** | | Prepare a Spur Gear on 3D printer with the given dimensions |
| **9.** | Robotics | Perform basic pick-and-place operation using robot |
| **10.** | Printed Circuit Board (PCB) | Design and fabricate a PCB for a given application |
| **11.** | Internet of Things (IoT) | Measure the temperature and humidity by using DHT11 sensor and Arduino UNO |
| **12.** | | Create a smart plant watering system using IoT |
| **Course Project** | | • Students are required to create an affordable prototype as their course project, based on the knowledge and skills acquired during the course.<br>• Students have to present and submit their prototypes to demonstrate their ability to apply classroom learning practically, showcasing their creativity and technical aptitude. |

**Laboratory Manual:**

- ***IDEA Lab Makerspace*** *Laboratory Manual & Record Book (LMRB) prepared by the faculty of department of Mechanical Engineering, KITSW, Revised version 4, August-2024*

**Text/ Reference Book(s):**


1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy., "*Elements of Workshop Technology*", Media Promoters and publishers Pvt. Ltd, India, Vol-I-2008 &Vol-II-2010
2. Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani, "*Additive Manufacturing Technologies-3D Printing, Rapid Prototyping, and Direct Digital Manufacturing*" Springer Nature, 2nd

Edition 2021
3. R.S. Khandpur, "*Printed Circuit Boards: Design, Fabrication, Assembly and Testing*", New Delhi Tata Mc Graw Hill-2008
4. Sudeep Mishra, Anandarupmukherjee and Arijit Roy, "*Introduction to IoT*", New Delhi: University Cambridge Press, 2021

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to …*

*(based on psychomotor skills acquired from laboratory component)*

CO1: produce wooden joints and intricate articles using carpentry and CNC wood router respectively

CO2: implement procedures to prepare the mould cavity for sand casting and arc welding joints

CO3: produce innovative prototypes using laser engraving and 3D printing

CO4: design and develop systems based on PCB and IoT for given applications

| **Course Articulation Matrix (CAM):** | | **U24AE107 IDEA Lab Makerspace** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24AE107.1** | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | - | 1 | 1 | 1 |
| **CO2** | **U24AE107.1** | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | - | 1 | 1 | 1 |
| **CO3** | **U24AE107.1** | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | - | 1 | 1 | 1 |
| **CO4** | **U24AE107.1** | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | - | 1 | 1 | 1 |
| **U24AE107** | | **2** | **2** | **1** | **1** | **2** | **1** | **1** | **2** | **2** | **-** | **1** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PRACTICUM-1

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I-Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24EL108** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-4-4** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** literature review and identifying research gaps

**LO2:** implementing a project independently by applying knowledge to practice

**LO3:** preparing well-documented report and informative PPT

**LO4:** effective technical presentation and creating video pitch

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

| Course | U24MH101 | U24PS102 | U24EC103 | U24CS104 | U24EE105 | U24CH106 |
|---|---|---|---|---|---|---|
| Students allotted to different courses | B24XX001 | B24XX011 | B24XX021 | B24XX031 | B24XX041 | B24XX051 |
| | B24XX002 | B24XX012 | B24XX022 | B24XX032 | B24XX042 | B24XX052 |
| | B24XX003 | B24XX013 | B24XX023 | B24XX033 | B24XX043 | B24XX053 |
| | B24XX004 | B24XX014 | B24XX024 | B24XX034 | B24XX044 | B24XX054 |
| | B24XX005 | B24XX015 | B24XX025 | B24XX035 | B24XX045 | B24XX055 |
| | B24XX006 | B24XX016 | B24XX026 | B24XX036 | B24XX046 | B24XX056 |
| | B24XX007 | B24XX017 | B24XX027 | B24XX037 | B24XX047 | B24XX057 |
| | B24XX008 | B24XX018 | B24XX028 | B24XX038 | B24XX048 | B24XX058 |
| | B24XX009 | B24XX019 | B24XX029 | B24XX039 | B24XX049 | B24XX059 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | B24XX010 | B24XX020 | B24XX030 | B24XX040 | B24XX050 | B24XX060 |

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

**CIRCULAR**

*Allotment of Practicum topics to students*

*Section : …….*

| S.No. | Roll number of the student | Practicum topic allotted | Practicum under the course | Course faculty |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Note:

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and also outside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

*(Signature of class teacher)*

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix). A sample rubrics for assessment and evaluation of practicum is as follows:

| | |
|---|---|
| Literature survey & Identification of research gaps | 10 marks |
| Working model / process / software package / system developed | 30 marks |
| Report writing (subjected to max of 30% plagiarism) | 20 marks |

| | |
|---|---|
| Oral presentation with PPT and viva-voce | 20 marks |
| Video pitch | 20 marks |
| **Total** | 100 marks |

**Note:** It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(a) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(b) **Working Model**: Each student is required to develop a prototype / process / system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(c) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggest for addressing the identified gaps for future work?

(d) **Anti-Plagiarism Check:** The practicum report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacher as per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(g) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce
ii) he/she fails to submit the report in prescribed format
iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: synthesize literature survey, identify research gaps and define objective & scope of practicum problem

**CO2**: apply knowledge to design & conduct experiments, utilize modern tools for solution

of practicum problem and develop working model/ process/ system

**CO3**: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

**CO4**: create a video pitch on practicum and make an effective oral presentation using PPTs

| **Course Articulation Matrix (CAM):** | | **U24EL108 PRACTICUM-1** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24EL108.1** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO2** | **U24EL108.2** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO3** | **U24EL108.3** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO4** | **U24EL108.4** | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **U24EL108** | | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

## SOCIAL EMPOWERMENT ACTIVITY -1 / SELF ACCOMPLISHMENT ACTIVITY – 1 (SEA -1/SAA-1)

| | | | |
|---|---|---|---|
| **Class:** B.Tech. I-Semesters | **Branch:** Common to all branches | | |
| **Course Code:** | **U24VA109** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-2-2** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1: holistic development** through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

**LO2: positive mindset** by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

**LO3:skills for effective fieldwork practice,** which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

**LO4: making a well-documented report and an effective oral presentation** through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) is introduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual and social aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses, which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (Self Accomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester, through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

***Monitoring SEA/SAA:***

(a) **Nodal units:** The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE) shall act as nodal units for activities listed

under SEA/SAA.

(b) During the semester period, the student has to **acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) **Knowledge Acquisition & Skilling**:

i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

**iii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

*Eminent personalities/ Achievers / Renowned personalities:*

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interact eminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication

etiquettes for getting appointment and time for interaction

ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

x. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xi. Student is expected to take care of health and Safety practices for fieldwork and travel

xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xiv. **Feedback:** The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration/Presentation and Report**: Student after presentation/ demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

i. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

ii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan

(oriented workflow) for attaining the identified goals.

iii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

iv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

v. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(g) ***Assessment & Evaluation:*** There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA.* The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

The CIE for SEA/SAA is as follows:

| Assessment | Maximum marks | Marks to be awarded by |
|---|---|---|
| Goal setting, Planning & Knowledge Acquisition | 20 | Nodal centre |
| Field work | 40 | Nodal centre |
| Demonstration/Presentation | 20 | Nodal centre |
| Report submission | 20 | Faculty counsellor |
| **Total** | **100** | **-** |

***Note:***

(a) **<u>Presentation/ Demonstration:</u>** It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
b. scores a minimum of 40 marks in the CIE of the course

(e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensitivity

**CO2**: interact effectively through written, oral and nonverbal communication with external world in a professional, sensitive and culturally relevant manner

**CO3**: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensitivity

**CO4**: demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learnin

**Text / Reference book(s):**

*For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator*

| **Course Articulation Matrix (CAM):** | | **U24VA109ZZ SEA-1/ SAA-1** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PS O 1** | **PS O2** |
| **CO1** | **U24VA109.1** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO2** | **U24VA109.2** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO3** | **U24VA109.3** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO4** | **U24VA109.4** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **U24VA109** | | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| 3 – HIGH, 2 – MEDIUM, 1 – LOW | | | | | | | | | | | | | | |

**Course Code**: **U24VAXYY(SE/SA)ZZZ**

***X represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets***

| Ex: If A student selects a SEA/SAA course as below: | Ex: If A student selects a SEA/SAA course as below: |
|---|---|
| *Semester: 1*<br>*SEA/SAA course serial number: 09*<br>*SEA/SAA category: SEA*<br>*course number: 302*<br>The **course code** will be U24VA109SE302 | *Semester: 4*<br>*SEA/SAA course serial number: 10*<br>*SEA/SAA category: SAA*<br>*course number: 206*<br>The **course code** will be U24VA410SA206 |

# EXPERT TALK SERIES-1

| | | | |
|---|---|---|---|
| **Class:** B.Tech I -Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24AE110** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-1-1** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in / on…*

**LO1:** 21st century skills needed for industry, current industry trends, challenges and innovations

**LO2:** latest technology in practice and applying knowledge to solve real-world problems

**LO3:** smart work, soft skills, professional etiquette, networking abilities

**LO4:** making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

**In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important**.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples, is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

**But how would you know all this without venturing into the industry?**

(e) The answer is Industry **Expert Talk Series (ETS)**. Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(f) Through Industry expert talks students get to know so much more that textbooks don't explain.

(g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(i) ETS helps students gain improved industry engagement for an easier transition into

the workplace, broader career progression opportunities and personal development.

(j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(l) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(m) ETS enhances your learning in many ways for global opportunities for your career.

(n) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(o) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks (10 MCQs/FiBs ; *duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

*Rubrics for evaluation of ETS*

| | |
|---|---|
| Quiz score<br>(*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*) | 60 marks |
| Attendance (*out of 10 quizzes*) | 20 marks |
| Report in prescribed format (*max 30% plagiarism*) | 20 marks |
| **Total** | 100 marks |

i. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

**ii. Supplementary Exam:**

(a) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE

(b) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; *duration: 2Hrs*) on the content covered in ETS lectures.

(c) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(d) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1:** identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

**CO2:** identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

**CO3:** interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

**CO4:** demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

| **Course Articulation Matrix (CAM):** | | **U24AE110 EXPERT TALK SERIES-1** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | U24AE110.1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO2** | U24AE110.2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO3** | U24AE110.3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO4** | U24AE110.4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **U24AE110** | | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **1** | **2** | **1** | **2** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

# Semester -II Syllabi

**URR24 - II SEMESTER**
**Stream-I**

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | O | E | C |
| 1 | BSC | U24MH201 | Matrix Theory and Vector Calculus | 2 | 1 | - | 6 | 9 | 3 |
| 2 | BSC | U24CY202B | Engineering Chemistry *(for ECIE)* | 2 | 1 | 2 | 5 | 10 | 4 |
| 3 | PCC | U24CI203 | Analog Electronics | 2 | 1 | - | 4 | 7 | 3 |
| 4 | ESC | U24CI204 | Data Structures through C | 2 | 1 | 2 | 5 | 10 | 4 |
| 5 | HSMC | U24MH205 | English Communication and Report Writing | 2 | - | - | 3 | 5 | 2 |
| 6 | VAC | U24VA206 | Sports and Yoga | - | - | 2 | 2 | 4 | 1 |
| 7 | ESC | U24ME207 | Engineering Graphics through CAD | - | - | 2 | 2 | 4 | 1 |
| 8 | SEC | U24SE208 | Programming Skill Development (PSD) Lab - 1 | - | - | 2 | 2 | 4 | 1 |
| 9 | ELC | U24EL209 | Practicum-2 | - | - | - | 4 | 4 | 1 |
| 10 | VAC | U24VA210 | SEA-2 / SAA -2 | - | - | - | 2 | 2 | 1 |
| 11 | AEC | U24AE211 | Expert Talk Series-2 | - | - | - | 1 | 1 | 1 |
| | | | **Total:** | **10** | **4** | **10** | **36** | **60** | **22** |
| Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet) | | | | - | - | - | - | - | - |

| **Exit Options to Qualify for UG Certificate in ECIE: Any Two (02) Courses during the 2 - Months internship** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **S. No.** | **Category** | **Course Code** | **Course Title** | **L** | **T** | **P** | **O** | **E** | **C** |
| **1** | **PCC** | **U24CI212X** | Digital Electronics | **2** | **-** | **2** | **-** | **4** | **3** |
| **2** | **PCC** | **U24CI213X** | Operational Amplifiers and Applications | **2** | **-** | **2** | **-** | **4** | **3** |
| **3** | **PCC** | **U24CI214X** | Communication Systems | **2** | **-** | **2** | **-** | **4** | **3** |
| **4** | **PCC** | **U24CI215X** | Any other course approved by BoS Chair and Dean AA | **2** | **-** | **2** | **-** | **4** | **3** |

# MATRIX THEORY AND VECTOR CALCULUS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II -Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24MH201** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-1-0-6-9** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

LO1: various methods of solving system of linear equations and eigen value problems
LO2: double integral, triple integral and their applications
LO3: vector differential calculus and applications
LO4: integration of vector valued functions and applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Matrices:**

Rank of a Matrix, Elementary transformations of a matrix, Gauss Jordan method of finding the inverse, Normal form of a matrix, Consistency of linear system of equations, System of linear homogenous equations, Eigen values, Eigen vectors, Properties of Eigen values, Cayley Hamilton's theorem, Reduction to diagonal form, Factorization method (LU Decomposition)
Applications of Eigen value problems: Stretching of an elastic membrane, Eigen value problems arising from Markov processes, Eigen value problems arising from population models, Leslie model

***Self-Learning Topics (SLTs):*** *Review of Matrices [Text 1: topics 2.1,2.2,2.3,2.4,2.5]*
*PAQ –Normal form [Text 1, topic 2.7(7), Solved problems: 2.26, Practice problems: exercise 2.4 (9,10)]*
*Additional problems on System of homogeneous and non-homogeneous equations [Text 1: topic 2.18, Solved problems: 2.52, Practice problems: exercise 2.10 (13,14)]*
*Additional problems on Eigen values and Eigen vectors [Text 2: topic 8.1, Solved problems: 8.1(1,2), Practice problems: exercise 8.1(4,6)]*
*Nature of Quadratic form [Text 1: topic 2.18, Solved problems: 2.52, Practice problems: exercise 2.10 (13,14))*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Multiple Integrals and Beta, Gamma functions:**

Double Integrals, change of order of integration, Double Integrals in polar coordinates, Area enclosed by plane curves, Triple integrals, Volumes of solids, Calculation of Mass for a plane lamina, Beta function, Gamma function, Relation between Beta and Gamma functions (without proof).

***Self-Learning Topics (SLTs):*** *Review of integrals [Text 1: topic Appendix VII (1)*
*Additional problems on change of order of integration [Text 1: topic 7.2, Solved problems: 7.4,7.6, Practice problems: exercise 7.1 (9,14))*
*Centre of gravity of a plane lamina [Text 1: topic 7.10, Solved problems 7.34,7.35, Practice problems: exercise 7.6 (9,10)]*
*Moment of Inertia of plane lamina [Text 1: topic 7.12(1,2), Solved problems: 7.37,7.38, Practice problems: exercise 7.7 (1,4)]*
*Additional problems on Volume of solids [Text 1: topic 7.6, Solved problem: 7.21, Practice problems: exercise 7.4 (12,25)]*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Vector Calculus and its applications:** - Vector Space, Linear dependent and independent vectors, Differentiation of vectors, Curves in space, Tangent, Principal normal, Binormal, Curvature, Torsion, Velocity and acceleration, Scalar and vector point functions, Del applied to scalar point functions - Gradient, Geometrical interpretation, Directional derivative, Del applied to vector point functions -Divergence, Curl, Physical interpretation of divergence, Physical interpretation of curl, Del applied twice to point functions, Del applied to products of point functions, Decomposition of vector valued functions

***Self-Learning Topics (SLTs):*** *Review of vectors [Text 2: topics 9.1, 9.2, 9.3]*
*Vector identities [Text 1: topic 8.9, Solved problems: 8.22, 8.23, Practice problems: exercise 8.4 (13,14)]*
*Additional problems on Directional derivatives [Text 1: topic 8.5(3), Solved problems: 8.13,8.14, Practice problems: exercise 8.3 (4,6,8,9)]*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Integration of vectors:**
Line integral, Surfaces-Surface integral, flux across a surface, Green's theorem in the plane (without proof), Stoke's theorem (Relation between line and surface integrals) (without proof), Volume integral, Gauss divergence theorem (Relation between surface and volume integrals) (without proof), irrotational fields, solenoidal fields

***Self-Learning Topics (SLTs):*** *Additional problems on Green's theorem [Text 1: topic 8.13, Solved problems: 8.33,8.35, Practice problems: exercise 8.8 (1,2,4)]*
*Additional problems on Stoke's theorem [Text 1: topics 8.14, Solved problems: 8.39, 8.40, Practice problems: exercise 8.9 (1,2)]*
*Additional problems on Gauss Divergence theorem [Text 1: topic 8.16, Solved problems: 8.44,8.46, Practice problems: exercise 8.10 (1,2)]*

**Course Learning Outcomes (COs):**
*After completion of this course, the students should be able to…*
CO1: analyze eigen value problems using matrix theory
CO2: apply basic concepts of multiple integrals in evaluating physical quantities of real-life engineering problems
CO3: apply differential operators on vector and scalar point functions
CO4: solve line, surface, volume integrals and correlate these with applications of Green, Stoke and Gauss divergence theorems

**Textbook(s):**
1. Grewal, B.S., *Higher Engineering Mathematics*, Khanna Publishers, Delhi, 44th edition, 2017 (Chapters 2,7,8)
2. Kreyszig E, *Advanced Engineering Mathematics*, Inc, U.K, John Wiely & Sons, 10th edition, 2020 (Chapter 8(8.2))

**Reference Book(s):**
1. Spiegel M, *Vector Analysis* -Schaum's Series, McGraw Hill, 2nd edition, 2017
2. S.S. Sastry, *Engineering Mathematics, Vol.II,* Prentice Hall of India, 3rd edition, 2014
3. Gilbert Strang, *Introduction to Linear Algebra*, Wellesley-Cambridge Press, 5th edition

**Web and Video link(s):**
1. https://youtu.be/L4crGhtEX14?si=hyjAPgDheJOhXtYZ : *NPTEL Video Lecture on Matrix Analysis with Applications/Dr.S.K.Gupta and Dr.Sanjeev Kumar/IIT Roorkee*
2. https://youtu.be/ksS_yOK1vtk?si=CNNA58OIuszubPiX : *NPTEL Video Lecture on Integral and Vector Calculus./Prof.Hari Shankar Mahato / IIT Kharagpur*

| Course Articulation Matrix (CAM): | | U24MH201 MATRIX THEORY AND VECTOR CALCULUS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24MH201.1 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO2 | U24MH201.2 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO3 | U24MH201.3 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO4 | U24MH201.4 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **U24MH201** | | **2** | **2** | **1** | **1** | **-** | **-** | **-** | **1** | **1** | **-** | **1** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# ENGINEERING CHEMISTRY

***(for ECIE)***

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II -Semester | | **Branch:** ECIE | |
| **Course Code:** | **U24CY202B** | **Credits:** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** electrochemical energy systems, batteries and fuel cells
**LO2:** water analysis, corrosion and preventive methods
**LO3:** UV, Visible, IR spectroscopy and flame photometry
**LO4:** mass spectroscopy and chromatography

**THEORY COMPONENT**

| **UNIT-I** | **9 Hrs** |
|---|---|

**Electrochemical Energy Systems**: Specific conductance, Equivalent conductance, Effect of dilution; Conductometric titrations-Acid base titrations-Strong acid Vs strong base, Weak acid Vs strong base, Strong acid Vs weak base and Weak acid Vs weak base; Electrode potential, pH meter, Principle of pH measurements, Electrodes, pH meters, Nernst equation; Potentiometric titrations-Acid base titrations; Biosensors
**Batteries**: Primary and secondary batteries-Lead acid battery and Li ion battery
**Fuel cells**: Hydrogen-oxygen fuel cell

***Self Learning Topics (SLTs):*** *Types of conductors (Text1: chapter 5 topic 1), Ohms law (Text1: chapter 5 topic 5)*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Water Technology and Corrosion:** Hardness of water, Estimation of hardness of water by complexometry, Alkalinity, Determination of alkalinity, Numerical problems, Determination of fluoride by spectrophotometry, Ion-exchange method, Reverse osmosis, Electro dialysis; Quality parameters of potable water (BIS and WHO)

**Corrosion:** Dry corrosion, Wet corrosion, Pilling-Bedworth rule, Effect of purity, Relative areas of anodic and cathodic parts, Nature of surface film, Humidity, pH and temperature on corrosion; Cathodic protection-Impressed current cathodic protection, Sacrificial anodic protection; Electroplating

***Self Learning Topics (SLTs): H****ard water and soft water, Units of hardness (Text1: chapter 1 topic 5), Introduction to Corrosion (Text1; chapter 7 topic 1), Galvanic series (Text1: chapter 7 topic 12)*

| **UNIT-III** | **9 Hrs** |
|---|---|

**UV-Visible Spectroscopy:** Lambert-Beer's law, Instrumentation, Formation of absorption bands, Theory of electronic spectroscopy, Fluorescence, Phosphorescence; Applications of UV-Visible spectroscopy

**IR-Spectroscopy:** Principle, Theory of molecular vibrations, Selection rules, Spectral features of some classes of compounds, Important features of IR spectroscopy and applications

**Flame photometry:** Principle of flame photometry, Instrumentation, Applications

***Self Learning Topics (SLTs):*** *Electromagnetic spectrum (Text1; chapter 35 topic 1), Atomic emission spectroscopy (Text1; chapter 35 topic 26), Atomic absorption spectroscopy (Text1; chapter 35 topic 28)*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Mass Spectroscopy:** Basic principle, Instrumentation, Determination of molecular formulae, Important features of mass spectroscopy, Mass analyzers

**Chromatography:** Chromatography, Basic definitions, Gas chromatography, Basic parts of a gas chromatography, Methods of measurement of peak areas

**Liquid Chromatography:** Liquid chromatographs, Types of liquid chromatography, column, Thin layer chromatography

***Self Learning Topics (SLTs):*** *Types of spectra (Text1: chapter 35 topic 3), introduction to chromatography (Text1: chapter 33 topic 1)*

**LABORATORY COMPONENT**

**List of Experiments**

1. Estimation of hydroxide ion [$OH^-$] by acidimetry using standard sodium carbonate solution
2. Estimation of alkalinity of water sample containing (i) carbonate; (ii) carbonate & bi carbonate in ground water
3. Estimation of alkalinity of water sample containing (i) bicarbonate; (ii) carbonate & hydroxide in potable water
4. Determination of hardness of water by complexometric method
5. Determination of dissolved oxygen in a sample of water
6. Standardization of sodium hydroxide (NaOH) by conductometry using standard hydrochloric acid (HCl)
7. Standardization of acetic acid ($CH_3COOH$) by conductometry using standard sodium hydroxide (NaOH)
8. Standardization of strong acid hydrochloric acid (HCl) by potentiometry using standard sodium hydroxide (NaOH)
9. Colorimetric analysis-verification of Lambert-Beer's law
10. Estimation of ferrous ($Fe^{+2}$) ion in the given solution using potassium permanganate
11. Preparation of nanoparticles of cadmium sulphide (CdS)
12. Synthesis of polymer (phenol- formaldehyde)

**Textbook(s):**

1. Jain and Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company, 17th edition, 2019

**Reference Book(S):**

1. J. C. Kuriacose and J. Rajaram, *Chemistry in Engineering and Technology* (vol. I & vol. II), Tata Mc. Graw-Hills Education Pvt. Ltd., 2010
2. Shashi Chawla, *Text book of Engineering Chemistry*, Dhanpat Rai Publishers, 3rd edition, 2003
3. S. S. Dara, S. S. Umare, *A Text book of Engineering Chemistry*, S. Chand & Company Ltd., 12th edition, 2010

**Web and Video link(s):**

1. *https://elearn.nptel.ac.in/shop/iit-workshops/completed/battery-cell-technology-materials-and-industrial-applications/?v=c86ee0d9d7ed NPTEL Video Lecture on Battery technology by Dr. Kothandaraman, Professor of Chemistry, IIT Madras & Dr. Raghunathan, Professor of Chemical engineering, IIT Madras*

**Laboratory Manual (for laboratory component):**

1. *Engineering Chemistry laboratory manual and Record Book,* Department of PS, KITSW

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*
*(based on cognitive skills acquired from theory component)*

**CO1**: apply the concepts of electrochemical energy systems for batteries and fuel cells
**CO2**: interpret suitable techniques of water analysis and corrosion treatment of solid

materials
**CO3**: determine the constituent elements of a sample using UV Visible and IR spectroscopy
**CO4**: apply techniques of mass spectroscopy and chromatography for analysis of samples
*(based on psychomotor skills acquired from laboratory component)*
**CO5**: estimate hydroxide ion and alkalinity of water sample
**CO6**: determine total hardness and oxygen dissolved in water
**CO7**: determine molarities of acids and bases
**CO8**: prepare nano materials and polymers

| **Course Articulation Matrix (CAM):** | | **U24CY202B ENGINEERING CHEMISTRY (*for ECIE*)** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CY202B.1** | 2 | - | - | - | 1 | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| **CO2** | **U24CY202B.2** | 2 | - | - | - | 1 | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| **CO3** | **U24CY202B.3** | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| **CO4** | **U24CY202B.4** | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | - | - | 1 | 1 |
| **CO5** | **U24CY202B.5** | 2 | 1 | - | - | - | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| **CO6** | **U24CY202B.6** | 2 | 1 | - | - | 2 | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| **CO7** | **U24CY202B.7** | 2 | 1 | - | - | - | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| **CO8** | **U24CY202B.8** | 2 | 1 | - | - | - | 1 | 1 | - | 1 | - | 1 | 1 | 1 |
| **U24CY202B** | | **2.00** | **1.33** | **2.00** | **1.50** | **1.20** | **1.00** | **1.00** | **1.00** | **1.00** | **-** | **1.00** | **-** | **1.00** |

# ANALOG ELECTRONICS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II -Semester | **Branch:** Common to ECI and EEE | | |
| **Course Code:** | **U24CI203** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-1-0-4-7** | **CIE :** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE :** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** small signal low frequency analysis of transistor amplifier circuits
**LO2:** frequency response of RC-coupled amplifier and JFET & MOSFET characteristics
**LO3:** negative feedback amplifier circuits
**LO4:** oscillator circuits and large signal amplifiers

| **UNIT-I** | **9 Hrs** |
|---|---|

**Bipolar Junction Transistor (BJT) Biasing:** Bias stability - Need for biasing, Operating point, Thermal runaway; Stability factor (S), Methods of BJT biasing - Fixed bias, Collector to base bias, Self bias

**Small Signal Low Frequency Transistor Amplifier Circuits:** BJT small signal low frequency h-parameter model, Analysis of transistor amplifier circuits using h-parameters, Analysis of single stage CE transistor amplifier circuits, Hybrid- Л(pi) Common emitter transistor model

***Self Learning Topics (SLTs): E****mitter feedback bias (Text1: topics6.12.2), Simplified CE and CC h-parameter model (Ref1: topics 12.4 , 12.5), Solved problems (Text1: Examples 6.30, 6.37,6.41), Solved problems (Text1:Examples 9.3, Prob 9.4)*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Multistage Amplifiers :** Different coupling schemes used in cascading of amplifiers, Choice of transistor configurations in cascading, Effect of cascading on gain and bandwidth, Frequency response of RC coupled amplifier, Emitter follower, Darlington connection

**Junction Field Effect Transistor (JFET) :** Construction and operation, Characteristic parameters of JFETs, Drain & transfer characteristics, FET as a switch, Analysis of single stage FET amplifier, Metal Oxide Semiconductor Field Effect Transistor(MOSFET) – structure and operation of Enhancement MOSFET and Depletion MOSFET

Self Learning ***Topics (SLTs):*** *General analysis of cascade amplifier(Text1: topics10.3) , cascode amplifier (Text1: topics 10.3,10.9), solved problem(Text1:Example10.1)*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Feedback Amplifiers:** Basic concept of feedback, Negative feedback amplifiers - Characteristics, Effect of negative feedback, Topologies; Analysis of voltage series, Voltage shunt, Current series and Current shunt feedback amplifiers

***Self Learning Topics (SLTs):*** *effect of feedback on input and output impedances (Text1:topics14.6.14.7), Solved problems (Text1: Prob 14.7, Prob 14.10,14.13)*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Oscillators:** Conditions for oscillations (Barkhausen criterion), RC and LC oscillators, Crystal Oscillator

**Large Signal Amplifiers**: Classification based on biasing, Series fed and transformer coupled Class A amplifier, Class B power amplifier, Push-pull and complementary symmetry Class B amplifiers, Cross over distortion, Class-AB power amplifier

***Self Learning Topics (SLTs):*** *classification of oscillators (Text1:topics 15.2),Second and higher order harmonic distortion(Text1: topics 12.4,12.5), Thermal stability and heat sinks (Text1: topics 12.9)*

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1**: design biasing circuits for BJT amplifier and apply h-parameters to determine the gain & impedance of BJT amplifiers

**CO2**: analyze the frequency response of RC coupled amplifier and volt-ampere characteristics of JFET &MOSFET

**CO3**: determine the gain and impedance of the feedback amplifier by identifying its topology

**CO4**: estimate the frequency of oscillations of given oscillator and efficiency of a large signal amplifier

**Textbook(s):**

1. S. Salivahana and N.Suresh Kumar, *Electronic Devices and Circuits*, McGraw Hill Education , New Delhi, 3rd edition, 2015

**Reference Book(s):**

1. Jacob Millman and C.C.Halkias, *Integrated Electronics*, Tata McGraw-Hill, New Delhi, 2nd edition, 1991
2. Robert L.Boylestad, Louis Nashelsky, *Electronic Devices and Circuit Theory*, Pearson education, New Delhi, 10th edition, 2013
3. Donald A Neamen, *Electronic Circuits Analysis and Design*, Tata McGraw-Hill, New Delhi, 3rd edition, 2009

**Web and Video link(s):**

1. https://www.youtube.com/watch?v=PSdHf6yozyc; *NPTEL Video Lecture on Transistor Biasing by Prof. T.S.Natarajan, Department of physics, IIT Madras*
2. https://www.youtube.com/watch?v=BSR26SU3R2U; *NPTEL Video Lecture on RC coupled amplifiers – frequency response by Prof. D.C. Dube, Department of Physics, IIT Delhi*
3. https://www.youtube.com/watch?v=xHNDrbB-iWY; *NPTEL Video Lecture on positive feedback and oscillations by Dr.Chitralekha Mahanta, Department of Electronics and Communication Engineering ,IIT Guwahati*
4. https://www.youtube.com/watch?v=4m49vM0Ryt8; *NPTEL Video Lecture on Field Effect Transistors Prof. T.S.Natarajan, Department of physics, IIT Madras*

| **Course Articulation Matrix (CAM):** | | **U24CI203 ANALOG ELECTRONICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI203.1** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO2** | **U24CI203.2** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO3** | **U24CI203.3** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO4** | **U24CI203.4** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| | **U24CI203** | **2** | **2** | **-** | **-** | **-** | **-** | **1** | **1** | **1** | **1** | **1** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# DATA STRUCTURES THROUGH C

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II –Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24CI204** | **Credits:** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** time complexity, space complexity, array operations, and dynamic memory allocation
**LO2:** stacks and various forms of queues
**LO3:** various types of linked lists
**LO4:** various sorting techniques and hashing techniques

**THEORY COMPONENT**

**UNIT-I** **9 Hrs**

**Data Structures:** Basic terminology, Classification of data structures, Applications and operations on data structures, Time and space complexity

**Arrays**: Operations on arrays-traversing an array, Inserting an element in an array, Deleting an element from an array, Searching an element using binary search and their complexities,

**Dynamic Memory Allocation:** Memory allocation functions, Dynamic memory allocation for single and two dimensional arrays

***Self Learning Topics (SLTs):*** *Three dimensional and n-dimensional arrays (Text1: topics 2.4.3), passing arrays to functions and pointers (Reference1: topics 3.6, 3.7), Practice problems (Text1: Prob 2.3, Reference1: Prob 1,Prob 2,Prob 3,Prob 4)*

**UNIT-II** **9 Hrs**

**Stacks:** stacks, Array representation of stacks, Operations on a stack–push and pop; Multiple stacks, Applications of stacks- recursion, Fibonacci series, tower of Hanoi, evaluation of expressions (infix to postfix conversion, evaluation of postfix expression)

**Queues:** queues, Array representation of queues, Double ended queues, Circular queues

***Self Learning Topics (SLTs):*** *Infix to prefix (Reference1: topics 7.7.3), priority Queue(Reference1: 8.4.3), Solved problems (Reference1: Prob 7.7.1, Prob 7.7.2), Practice problems (Text1: Prob 4.5, Prob 4.11, Prob 5.7, Prob 5.9 )*

**UNIT-III** **9 Hrs**

**Linked Lists**: Basic terminologies, Linked list versus arrays, Memory allocation and de-allocation for a linked list, Singly linked list, Circular linked list, Doubly linked list, Circular doubly linked list (linked list operations- traversing, searching, inserting, deleting), Representing stack and queue using linked list

***Self Learning Topics (SLTs):*** *Merging (Text1: topics 3.3), Skiplist (weblink: https://www.geeksforgeeks.org/skip-list/ ), Deallocation strategy(Text1: topic 3.9), Solved problems (Text1: Prob 3.6.1, Prob 3.6.2), Practice problems (Reference1: Prob 5.5, Prob 5.7, Prob 5.9)*

**UNIT-IV** **9 Hrs**

**Sorting Techniques:** Selection sort, Insertion Sort, Shell sort and radix sort, Time complexities of sorting

**Hashing:** Hashing techniques, Collision resolution techniques, Closed hashing, Open hashing, Comparison of collision resolution techniques

**Self Learning Topics (SLTs):** Two way insertion sort *(Text1: topics 10.3.4), Comparison of sorting techniques(Reference1: topics 14.16) Solved problems (Reference1: Prob 15.5, Prob 15.6, Prob 15.7), Practice problems (Text1: Prob 6.4)*

**LABORATORY COMPONENT**

## List of Experiments

**Experiment-I**

1. Program to implement initialization of array and perform traversal operations in both the directions
2. Program to implement searching operation on array using Linear Search
3. Program to display the count of occurrences of every number in an array

**Experiment-II**

4. Program to implement searching operation on array using Binary Search
5. Program to implement insertion operation on array
6. Program to implement deletion operations on array

**Experiment-III**

7. Program to implement initialization of arrays and traversal operation with DMA
8. Program to implement matrix addition and subtraction with DMA

**Experiment-IV**

9. Program to implement matrix multiplication with DMA
10. Program to implement stack operations
11. Program to convert infix expression into postfix

**Experiment-V**

12. Program to evaluate given postfix expression
13. Program to define recursive function to solve tower of hanoi puzzle
14. Program to display the Fibonacci series with the help of recursive function
15. Program to implement MultiStack

**Experiment-VI**

16. Program to implement queue operations using arrays
17. Program to implement circular queue operations using arrays
18. Program to implement double ended queue operations using arrays

**Experiment-VII**

19. Program to create single linked list and implement its operations
    Note:- Linked list Operations**:** i) traversing ii) inserting iii) deleting iv) searching v) reversing vi) concatenation

**Experiment-VIII**

20. Program to create circular linked list and implement its operations
21. Program to create double linked list and implement its operations

**Experiment-IX**

22. Program to create circular double linked list and implement its operations

**Experiment-X**

23. Program to implement stack operations using linked list
24. Program to implement queue operations using linked list

**Experiment-XI**

25. Program to implement selection sort
26. Program to implement insertion sort

**Experiment-XII**

27. Program to implement shell sort
28. Program to implement radix sort
29. Program to implement hash table.

**Textbook(s):**

1. Debasis Samanta, *Classic Data Structures*, Prentice Hall India, 2nd edition, 2009

**Reference Book(s):**

1. Reema Thareja, *Data Structures Using C*, Oxford University Press, 2nd edition, 2014
2. Balagurusamy E, *Data Structure Using C*, McGraw Hill Education, 1st edition, 2017
3. Richard F. Gilberg and Behrouz A. Forouzan, *Data Structures: A Pseudocode Approach with C*, Cengage Learning, 2nd Edition, 2007

**Web and Video link(s):**

https://nptel.ac.in/courses/106106130; *NPTEL Video Lecture on Programming and Data Structures Dr. N. S. Narayana Swamy, CSE, IIT Madras.*

**Laboratory Manual (for laboratory component):**

2. *Data Structures through C Laboratory Manual and Record Book,* Department of CSE (AI & ML), KITSW.

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1:** analyze and implement array operations by utilizing dynamic memory allocation and evaluating their time and space complexities

**CO2:** analyze and implement stack and queue data structures by utilizing array representations and evaluating their applications and operational complexities

**CO3:** analyze and implement various types of linked lists by utilizing dynamic memory allocation techniques and evaluating their operational complexities

**CO4:** develop various sorting algorithms, analyze their time complexities, and apply hashing techniques with collision resolution methods, comparing their efficiencies

*(based on psychomotor skills acquired from laboratory component)*

**CO5:** develop and test basic data structures and array operations, including dynamic memory allocation to evaluate their performance and complexity

**CO6:** apply the linear data structures such as stacks and queues and perform various operations using LIFO or FIFO order respectively

**CO7:** solve problems using various linked list representations for efficiently storing and retrieving the data

**CO8:** apply different sorting techniques on unsorted data and sort them in an order,

able to store the data using hashing techniques to retrieve the data very effectively

| Course Articulation Matrix (CAM): | | U24CI204 DATA STRUCTURES THROUGH C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CI204.1 | 2 | 2 | 2 | 1 | - | - | 1 | - | 1 | - | 1 | 2 | 1 |
| CO2 | U24CI204.2 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| CO3 | U24CI204.3 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| CO4 | U24CI204.4 | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| CO5 | U24CI204.5 | 2 | 2 | 2 | 1 | - | - | 1 | 1 | 1 | - | 1 | 2 | 1 |
| CO6 | U24CI204.6 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 1 | - | 2 | 2 | 2 |
| CO7 | U24CI204.7 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 1 | - | 2 | 2 | 2 |
| CO8 | U24CI204.8 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 1 | - | 2 | 2 | 2 |
| U24CI204 | | **2** | **2** | **2** | **1.75** | **-** | **-** | **1** | **1** | **1** | **-** | **1.75** | **2** | **1.75** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# ENGLISH COMMUNICATION AND REPORT WRITING

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II –Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24MH205** | **Credits:** | **2** |
| **Hours/Week (L-T-P-O-E):** | **2-0-0-3-5** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** basic grammar principles, reading speed, forming new words, making coherent paragraphs and also promoting ethical values for meaningful life.

**LO2:** speaking or writing correct sentences, writing effective letters and improving their self-worth.

**LO3:** critical reading ability, writing conclusive reports and additionally inculcating positive thinking.

**LO4:** abridging varieties of lengthy texts and maintaining emotional balance.

| **UNIT-I** | **6 Hrs** |
|---|---|

**GRAMMAR**

- Tenses-Structures-usage-examples-exercises for practice
- Sentence Correction-Correct use of Tenses, Verb forms, Punctuation.

**VOCABULARY**

- Word formation: Prefixes-Suffixes-Sentence Formation with newly formed words

**READING SKILL**

- Definition-Sub skills of Reading-Emphasis on Skimming-Purpose- How to skim through the text-Examples, Exercises for practice

**WRITING PRACTICES**

- Paragraph Writing- Definition-Organizing Principles of paragraphs -Making a paragraph through hints/graphs and pictures-Coherence-Linking Devices-Systematic Development of Ideas
- Paraphrasing-Précising lengthy expressions for clarity and brevity

**LIFE SKILLS**: Ethical Values and Humanity

The Last Leaf: A Short Story by O. Henry

## *Self Learning Topics (SLTs):*

*Articles-(Text 2,Unit-II), English Vocabulary (Text 2,Unit-I, Unit-II, Unit-III)*

*Verb Forms (Reference book 1,Topic :31), Tenses (Reference book 1,Topics: 16,17,18,19)*

*Reported Speech (Reference book 2, Exercises for Practice, Topics : 161-167)*

| **UNIT-II** | **6 Hrs** |
|---|---|

**GRAMMAR**

- Tenses-Revision-Exercises for practice
- Subject-Verb Agreement
- Reported Speech-Transformation
- Sentence Correction -Emphasis Concord ,Report Speech, Sentence Structures

**VOCABULARY**

- Synonyms-Antonyms-Single Word Substitutes-Popular Abbreviations

**READING STRATEGY**

- Emphasis on Scanning the Text-Purpose-Advantages-Examples, Exercises and Practice through Teamwork
- **WRITING PRACTICES**
- Letter Writing- Effective Letter Writing Techniques-Information Seeking Letters-Job Application Letters- Apology Letters-Explanation to Memos- E-mails-Cover Letters-Resume

**LIFE SKILLS**: Determination

- How I Became a Public Speaker: An essay by George Bernard Shaw

***Self Learning Topics (SLTs):*** *English Vocabulary (Text 2,Unit-I,Unit-II,Unit-III),Tenses*

*(Reference book 3,Topic-30, Exercises,30.1,30.2,30.3)*

| **UNIT-III** | **6 Hrs** |
|---|---|

**GRAMMAR**

- Tenses-Revision- Exercises for Practice
- Nouns- Prepositions-Adverbs-Adjectives
- Sentence Correction: Correct Use of tenses, nouns, prepositions, adverbs and adjectives

**VOCABULARY**

- Phrasal Verbs-Technical Words-Latin Words

**READING STRATEGY**

- Intensive Reading-purpose-Types of Comprehension Questions-Examples, Exercises and Practice through Teamwork

**WRITING PRACTICES**

- Report Writing-Definition-Purpose-Qualities of a Good Report- Formal and Informal Reports-Report Format-Sample Reports-Exercises
- Emphasis on Technical Reports

**LIFE SKILLS**: Positive Attitude

- Be the Best of Whatever You Are: A Poem by Douglas Malloch

***Self Learning Topics (SLTs):***

*Parts of Speech (Text book 1,Unit-I),Tenses (Reference book 1, Topics-16,17,18,19) Phrasal Verbs (Reference book 3 )*

| **UNIT-IV** | **6 Hrs** |
|---|---|

**GRAMMAR**

- Tenses-Revision-Exercises for Practice
- Clauses- Conjunctions-Transformation of Sentences
- Sentence Correction (Based on Parts of Speech)- Clauses- Tenses

**VOCABULARY**

- Appropriate Use of Words in Communication-Commonly Confused Words

**ACTIVE READING and NOTE-MAKING**

- Note-Making-Definition-Purpose-Effectiveness

**WRITING PRACTICES**

- Précis Writing- Definition-Purpose-Uses-Examples and Exercises-Practice through Teamwork
- Preparing Statement of Purpose (SoP)

**LIFE SKILLS:** Emotional Balance A Poison Tree: Poem by William Blake

***Self-Learning Topics (SLTs):***

Tenses (Reference book 2, Topics: 152-157))

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1**: apply basic grammar principles in speech and writing, read fast, form new words, make coherent paragraphs and adapt the real value of life.

**CO2**: create effective letters, e-mails, reply to Memos and do the given tasks with confidence.

**CO3**: analyze the given texts and write clear and unambiguous reports.

**CO4**: deduct the superfluous information from lengthy text, prepare SoP (Statement of Purpose) effectively and solve critical problems in life with emotional balance.

**Textbook(s):**

1. Sanjay Kumar & Pushp Lata, " *English Language and Communication Skills for Engineers*", Oxford University Press, 1st edition 2018
2. "*Language and Life: A Skill's Approach*" Based on the latest AICTE model curriculum Orient Blackswan Private Limited 2nd Edition 2019.

**Reference Book(s):**

1. Thomson A.J. , Martinet A.V., "*A Practical English Grammar*", Oxford University Press 3rd Edition 1997
2. Thomson A.J. ,.Martinet A.V, "*A Practical English Grammar*" Exercise 2 , Oxford University Press 3rd Edition 1997
3. Standard Allen W. , "*Living English Structure*", Pearson India Education Pvt Ltd. 5th Edition 2009

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc20_hs56/preview Technical English for Engineers by Aisha Icbal, IIT Madars
2. https://onlinecourses.swayam2.ac.in/cec21_lg13/preview

   Indian Writing in English by Dr.Bindu Ann Philip, St Mary's College Trissur

| **Course Articulation Matrix (CAM):** | | **U24MH105/205: ENGLISH COMMUNICATION &REPORT WRITING** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24MH105.1** | - | - | - | - | - | 1 | - | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO2** | **U24MH105.2** | - | - | - | - | - | 1 | - | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO3** | **U24MH105.3** | - | - | - | - | - | 1 | - | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO4** | **U24MH105.4** | - | - | - | - | - | 1 | - | 2 | 2 | 2 | 2 | 1 | 1 |
| **U24MH105/205** | | **-** | **-** | **-** | **-** | **-** | **1** | | **2** | **2** | **2** | **2** | **1** | **1** |

3 – HIGH, 2 – MEDIUM, 1 - LOW

# SPORTS and YOGA

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II-Semester | | **Branch: Common to all branches** | |
| **Course Code:** | **U24VA206** | **Credits:** | **0** |
| **Hours/Week(L-T-P-O-E):** | **0-0-2-2-4** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **24Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

LO1: yoga and Benefits

LO2: various Sports &Games

LO3: sportsman spirit

LO4: all round development

## Sports and Games

**List of Sports and Games**

| Sl. No. | Game | Sl. No | Game |
|---|---|---|---|
| 1 | Badminton | 7 | Volleyball |
| 2 | Basketball | 8 | Cricket |
| 3 | Chess | 9 | Hand Ball |
| 4 | Carrom | 10 | Kabaddi |
| 5 | Foot Ball | 11 | Kho-Kho |
| 6 | Table Tennis | 12 | Yoga Aasanas |

**Textbook(s):**

B.K.Chaturvedi, *Rules and Skills of Games and Sports,* Publisher – Goodwill Publishing House, B-9, Rattan Jyoti, 18 Rajendra Place, New Delhi.

**ReferenceBook(s):**

Dr.Sakure Girish Madhaorao, *Foundation of Physical Education and Sports*, Sports Publication, New Delhi.

**Web and Video link(s):**

Badminton game Video Link:

https://www.youtube.com/watch?v=HucIqi8Lw3E&t=22s

Basketball game Video Link:

https://www.youtube.com/watch?v=-tkE2lJoR58

Chess Video Link:

https://www.youtube.com/watch?v=mDw7lgM8ePo

Carrom game Video Link:

https://www.youtube.com/watch?v=z8vvJpNceeg

Football game Video Link:

https://www.youtube.com/watch?v=mXjW78AgGu4

Table Tennis game Video Link:

https://www.youtube.com/watch?v=bLrJGWvWI4U

Volleyball game Video Link:

https://www.youtube.com/watch?v=BJJb3-O0Q1U

Cricket game Video Link:

https://www.youtube.com/watch?v=87hO_Vs3-wQ

Handball game Video Link:

https://www.youtube.com/watch?v=VCa_0USaq8k

Kabaddi game Video Link:

https://www.youtube.com/watch?v=ai1m7ARNyNI

Kho-Kho game Video Link:

https://www.youtube.com/watch?v=P3_z3LKdLdg

Yoga Aasanas Video Link :

https://www.youtube.com/watch?v=e0Q88DUOXjk

https://www.youtube.com/watch?v=JoDKbXEUrvQ

**Course Learning Outcomes (COs):**

*After completion of this course, the student should be able to demonstrate …*

CO1: demonstrate physical fitness by performing yoga aasanas

CO2: demonstrate physical fitness through various games & sports events with defined benchmarks

CO3: demonstrate sportsman spirit and ethics

CO4: demonstrate physical, psychological, social and emotional balance

| **Course Articulation Matrix (CAM):** | | **U24VA206 Sports and Yoga for Common to all branches** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO1** | **PSO 2** |
| **CO1** | **U24VA206.1** | - | - | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO2** | **U24VA206.2** | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| **CO3** | **U24VA206.3** | - | - | - | - | - | - | 2 | - | - | - | - | - | - |
| **CO4** | **U24VA206.4** | - | - | - | - | - | - | - | - | 1 | - | 1 | - | - |
| **U24VA206** | | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **1** | **1** | **-** | **1** | **-** | **-** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# ENGINEERING GRAPHICS THROUGH CAD

| | | | |
|---|---|---|---|
| **Class:** B. Tech. II –Semester | | **Branch:** Common to all (except CE & ME) | |
| **Course Code:** | **U24ME207** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-2-2-4** | **CIE :** | **60 %** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE :** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

LO1: AutoCAD commands, projections of points and straight line inclined to one plane
LO2: projections of oblique planes
LO3: projections of solids and sections of solids
LO4: conversion of isometric, orthographic projections and simple circuits diagrams

**LABORATORY COMPONENT**

**List of Experiments**

1. Importance of Engineering Drawing, principles of engineering drawing, dimensioning; introduction to AutoCAD software-GUI, settings, standard toolbar, toolbars - draw, modify, dimension, properties, design centre and tool palettes
2. Introduction to orthographic projections-Vertical Plane, Horizontal plane; Views-Front view, Top view, and Side view and draw the Projection of points in different quadrants.
3. Draw the Projection of straight lines
4. Draw the Projection of planes
5. Draw the Projection of solids- Simple position(Axis perpendicular to HP or VP)
6. Draw the projections of solids inclined to both the planes
7. Draw the Sections of solids
8. Draw the Orthographic projections of given objects
9. Conversion of isometric view to orthographic projections
10. Draw the Isometric view from the given orthographic views
11. Draw the pictorial view (3D) from the given Isometric view
12. AutoCAD application in Electrical and Electronics circuits

**Textbook(s):**

1. Bhatt N.D., *Elementary Engineering Drawing*, Charotar Publishing House, Anand, India, 2017
2. Kulkarni D. M., Rastogi A. P., and Sarkar A., *Engineering Graphics with AutoCAD*, PHI publisher, revised edition, July 2010

**Reference Book(s):**

1. Dhananjay A Jolhe, *Engineering Drawing*, Tata Mc Graw- Hill, 2008
2. Venugopal K. *Engineering Graphics with Auto CAD*, New Age International Publishers Ltd., Hyderabad, 2012
3. Luzadder W.J and Duff J.M, *Fundamentals of Engineering Drawing*, Prentice-Hall of India, 1995

**Web and Video link(s):**

*https://onlinecourses.nptel.ac.in/noc20_me79/preview NPTEL video link for* ***Engineering drawing and computer graphics*** *By Prof. Rajaram Lakkaraju, IIT Kharagpur.*

**Laboratory Manual (for laboratory component):**

1. *Engineering Graphics through CAD Laboratory Manual & Record Book,* Dept. of ME, KITSW

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

CO1: draw projections of points and straight lines inclined to one plane with Auto CAD.

CO2: develop the projections of planes using Auto CAD

CO3: construct the projections of solids and sections of solids using Auto CAD

CO4: create orthographic and isometric projections and develop the simple electrical and electronic circuit using Auto CAD

**Course Articulation Matrix (CAM): U24ME207** ENGINEERING GRAPHICS THROUGH CAD

| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **U24ME207.1** | 2 | 1 | 1 | - | 2 | - | 1 | - | 2 | - | 1 | 1 | 1 |
| **CO2** | **U24ME207.2** | 2 | 1 | 1 | - | 2 | - | 1 | - | 2 | - | 1 | 1 | 1 |
| **CO3** | **U24ME207.3** | 2 | 1 | 1 | - | 2 | - | 1 | - | 2 | - | 1 | 1 | 1 |
| **CO4** | **U24ME207.4** | 2 | 1 | 1 | - | 2 | - | 1 | - | 2 | - | 1 | 1 | 1 |
| **U24ME207** | | **2** | **1** | **1** | **-** | **2** | **-** | **1** | | **2** | **-** | **1** | **1** | **1** |

# PRACTICUM-2

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II-Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24EL209** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-4-4** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** literature review and identifying research gaps

**LO2:** implementing a project independently by applying knowledge to practice

**LO3:** preparing well-documented report and informative PPT

**LO4:** effective technical presentation and creating video pitch

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

| Course | U24MH101 | U24PS102 | U24EC103 | U24CS104 | U24EE105 | U24CH106 |
|---|---|---|---|---|---|---|
| Students allotted to different courses | B24XX001 | B24XX011 | B24XX021 | B24XX031 | B24XX041 | B24XX051 |
| | B24XX002 | B24XX012 | B24XX022 | B24XX032 | B24XX042 | B24XX052 |
| | B24XX003 | B24XX013 | B24XX023 | B24XX033 | B24XX043 | B24XX053 |
| | B24XX004 | B24XX014 | B24XX024 | B24XX034 | B24XX044 | B24XX054 |
| | B24XX005 | B24XX015 | B24XX025 | B24XX035 | B24XX045 | B24XX055 |
| | B24XX006 | B24XX016 | B24XX026 | B24XX036 | B24XX046 | B24XX056 |
| | B24XX007 | B24XX017 | B24XX027 | B24XX037 | B24XX047 | B24XX057 |
| | B24XX008 | B24XX018 | B24XX028 | B24XX038 | B24XX048 | B24XX058 |
| | B24XX009 | B24XX019 | B24XX029 | B24XX039 | B24XX049 | B24XX059 |
| | B24XX010 | B24XX020 | B24XX030 | B24XX040 | B24XX050 | B24XX060 |

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

**CIRCULAR**

*Allotment of Practicum topics to students*

*Section : …….*

| S.No. | Roll number of the student | Practicum topic allotted | Practicum under the course | Course faculty |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Note:**

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and also outside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

*(Signature of class teacher)*

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix). A sample rubrics for assessment and evaluation of practicum is as follows:

| | |
|---|---|
| Literature survey & Identification of research gaps | 10 marks |
| Working model / process / software package / system developed | 30 marks |
| Report writing (subjected to max of 30% plagiarism) | 20 marks |
| Oral presentation with PPT and viva-voce | 20 marks |
| Video pitch | 20 marks |
| **Total** | 100 marks |

**Note:** It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(h) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(i) **Working Model**: Each student is required to develop a prototype / process /system/simulation model on the given practicum topic and demonstrate/ present, during the allotted time, before the course teacher.

(j) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?
- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggest for addressing the identified gaps for future work?

(k) **Anti-Plagiarism Check:** The practicum report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(l) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacher as per the schedule notified by the department

(m) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(n) The student has to register for the Practicum as a supplementary examination in the following cases:

iv) he/she is absent for oral presentation and viva-voce
v) he/she fails to submit the report in prescribed format
vi) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: synthesize literature survey, identify research gaps and define objective & scope of practicum problem

**CO2**: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system

**CO3**: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

**CO4**: create a video pitch on practicum and make an effective oral presentation using PPTs

| Course Articulation Matrix (CAM): | | U24EL209 PRACTICUM | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24EL2098.1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO2 | U24EL209.2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO3 | U24EL209.3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| CO4 | U24EL209.4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| U24EL209 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

## SOCIAL EMPOWERMENT ACTIVITY / SELF ACCOMPLISHMENT ACTIVITY (SEA-2 /SAA-2)

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II -Semesters | **Branch:** Common to all branches | | |
| **Course Code:** | **U24VA210** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-2-2** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** **holistic development** through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

**LO2:** **positive mindset** by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

**LO3:** **skills for effective fieldwork practice,** which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

**LO4:** **making a well-documented report and an effective oral presentation** through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) is introduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual and social aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses, which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (Self Accomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset.

(a) Each SEA/SAA activity is treated as one credit course

(b) Student must select one activity per semester, through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(c) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(d) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(e) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

***Monitoring SEA/SAA:***

(a) **Nodal units:** The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE) shall act as nodal units for activities listed under SEA/SAA.

(b) During the semester period, the student has to **acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(c) **Knowledge Acquisition & Skilling**:

i. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

ii. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

iii. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(d) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

i. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

ii. Fieldwork consists of three phases: preparation, the actual activity and feedback

**iii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**

iv. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

v. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

vi. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

vii. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

*Eminent personalities/ Achievers / Renowned personalities:*

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

viii. **For appointment to interact eminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for interaction

ix. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

x. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to

maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xi. Student is expected to take care of health and Safety practices for fieldwork and travel

xii. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xiii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xiv. **Feedback:** The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(e) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(f) **Flow process for completion of SEA/SAA course**:

vi. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

vii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

viii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

ix. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

x. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(g) ***Assessment & Evaluation:*** There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA.* The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

***The CIE for SEA/SAA is as follows:***

| Assessment | Maximum marks | Marks to be awarded by |
|---|---|---|
| Goal setting, Planning & Knowledge Acquisition | 20 | Nodal centre |
| Field work | 40 | Nodal centre |
| Demonstration/Presentation | 20 | Nodal centre |
| Report submission | 20 | Faculty counsellor |
| **Total** | **100** | **-** |

***Note:***

(a) **Presentation/ Demonstration:** It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(b) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(c) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(d) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
b. scores a minimum of 40 marks in the CIE of the course

(e) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must complete the same by enrolling it in the next higher semesters.

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensitivity

**CO2**: interact effectively through written, oral and nonverbal communication with external world in a professional, sensitive and culturally relevant manner

**CO3**: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensitivity

**CO4**: demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

**Text / Reference book(s):**

*For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator*

| **Course Articulation Matrix (CAM):** | | **U24VA210- SEA-2/ SAA-2** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24VA210.1** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO2** | **U24VA210.2** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO3** | **U24VA210.3** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO4** | **U24VA210.4** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **U24VA210** | | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

**Course Code**: **U24VA XYY(SE/SA)ZZZ**

***X represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets***

| Ex: If A student selects a SEA/SAA course as below: | Ex: If A student selects a SEA/SAA course as below: |
|---|---|
| *Semester: 1*<br>*SEA/SAA course serial number: 09*<br>*SEA/SAA category: SEA*<br>*course number: 302*<br>The **course code** will be U24VA109SE302 | *Semester: 4*<br>*SEA/SAA course serial number: 10*<br>*SEA/SAA category: SAA*<br>*course number: 206*<br>The **course code** will be U24VA410SA206 |

# EXPERT TALK SERIES - 2

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II -Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24AE211** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-1-1** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** 21st century skills needed for industry, current industry trends, challenges and innovations

**LO2:** latest technology in practice and applying knowledge to solve real-world problems

**LO3:** smart work, soft skills, professional etiquette, networking abilities

**LO4:** making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

**In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important**.

(a) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(b) Learning from industry experts with real-world examples, is important to enhance your educational experience.

(c) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(d) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

**But how would you know all this without venturing into the industry?**

(e) The answer is Industry **Expert Talk Series (ETS)**. Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(f) Through Industry expert talks students get to know so much more that textbooks don't explain.

(g) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(h) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(i) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(j) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(k) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry and how they need to groom themselves.

(l) Through ETS sessions, another benefit is that students learn the importance of soft skills like

communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(m) ETS enhances your learning in many ways for global opportunities for your career.

(n) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(o) Salient features of ETS are hereunder:

(i) ETS is offered from I semester to VI semester.

(ii) ETS, in any given semester, is treated as one credit course

(iii) Students are required to earn six credits (from I to VI semester)

(iv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(v) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.

(vi) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks (10 MCQs/FiBs ; *duration: 10-15 mins*), on the contents covered in the expert talk.

(vii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(viii) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(ix) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(x) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xi) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(p) The CIE for ETS is as follows:

*Rubrics for evaluation of ETS*

| | |
|---|---|
| Quiz score<br>(*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*) | 60 marks |
| Attendance (*out of 10 quizzes*) | 20 marks |
| Report in prescribed format (*max 30% plagiarism*) | 20 marks |
| **Total** | **100 marks** |

ii. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

**iii. Supplementary Exam:**

(e) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE

(f) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; *duration: 2Hrs*) on the content covered in ETS lectures.

(g) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(h) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1:** identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

**CO2:** identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

**CO3:** interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

**CO4:** demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

| **Course Articulation Matrix (CAM):** | | **U24AE210 EXPERT TALK SERIES-2** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | U24AE210.1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO2** | U24AE210.2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO3** | U24AE210.3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO4** | U24AE210.4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **U24AE210** | | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **1** | **2** | **1** | **2** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# I Year
# Exit Courses
# Syllabi

# DIGITAL ELECTRONICS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II –Semester (Exit) | | **Branch:** ECIE | |
| **Course Code:** | **U24CI212X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE :** | **60%** |
| **Total Number of Teaching Hours:** | **16Hrs** | **ESE :** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

***LO1:*** switching algebra and minimization techniques of switching functions
***LO2:*** combinational circuits and their applications
***LO3:*** flip flops and their use in the design of sequential circuits
***LO4:*** logic circuits using PLDs

**THEORY COMPONENT**

| **UNIT-I** | **4Hrs** |
|---|---|

**Number Systems and Codes: N**umber systems- representation, Binary arithmetic, Binary codes **Boolean Algebra and Minimization**: Postulates and theorems; Logic gates – Symbols and truth tables, Realization of switching functions - AOI, NAND-NAND and NOR-NOR realizations; 3 and 4 variable Karnaugh map minimization

| **UNIT-II** | **4Hrs** |
|---|---|

**Combinational circuits:** Design of combinational circuits using logic gates – Half adder, Full adder, Half subtractor, Full subtractor, Multiplexers, Demultiplexers, Decoders, Encoders

| **UNIT-III** | **4Hrs** |
|---|---|

**Sequential circuits:** Flip flops- SR, JK, D and T; Truth tables, Excitation tables, Race around condition, Master slave flip flop, Counters – Ripple counters, Synchronous counters; Ring and Johnson counters

| **UNIT-IV** | **4Hrs** |
|---|---|

**Programmable logic devices (PLDS):** Introduction to PLDs, read only memories (ROMs), programmable logic array devices (PLAs), Programmable array logic devices (PALs), Implementation of Boolean functions on PLDs

**LABORATORY COMPONENT**

**List of Experiments**

1. Implementation of Boolean functions using logic gates
2. Functional verification of decoder/de-multiplexer and realization of Boolean function
3. Implementation and functional verification of 4-2 Priority Encoder
4. Implementation of Half and Full Adders using logic gates
5. Realization Implementation of 4x1 multiplexer using logic gates
6. Design and functional verification of 4-bit Binary to Gray code converter
7. Design and functional verification of BCD to Excess-3 code converter
8. Functional verification of RS, JK, T and D flip-flops
9. Design and functional verification of 4-bit Shift Register
10. Functional verification of Ring and Johnson Counters

**Textbook(s):**

1. M. Morris Mano, *Digital Design*, PHI, 3rd edition, New Delhi , 2003

**Reference Book(S):**

1. R.P. Jain, *Modern Digital Electronics*, Tata McGraw-Hill, New Delhi, 3rd edition,2003
2. *A. Anand Kumar, Fundamentals of Digital Circuits, PHI, New Delhi, 3rd edition, 2014*
3. *Herbert Taub and Donald Schilling, Digital Integrated Circuits,Tata McGraw-Hill , New Delhi, 2008*

**Web and Video link(s):**

https://onlinecourses.nptel.ac.in/noc21_ee10/preview; *NPTEL Video Lecture on Digital Electronic Circuits by Prof. GouthamSaha, Professor of E&ECE, IIT Kharagpur.*

**Laboratory Manual (for laboratory component):**

1. *Digital Electronics Laboratory Manual and Record Book,* Department of ECIE, KITSW

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1:** apply minimization techniques to obtain minimal SOP/POS forms of switching functions

**CO2:** design combinational circuits such as adders, subtractors, decoders, multiplexers, demultiplexers

**CO3:** design sequential circuits using flip flops

**CO4:** design logic circuits using PLDs

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: develop logic circuits to implement Boolean functions and test the functionality

**CO6**: design and test the functionality of combinational circuits

**CO7**: design and test the functionality of asynchronous sequential circuits

**CO8**: design and test the functionality of synchronous sequential circuits

| **Course Articulation Matrix (CAM):** | | **U24CI212X DIGITAL ELECTRONICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI212X.1** | 2 | 2 | - | 1 | 1 | - | - | - | - | - | 1 | 1 | 1 |
| **CO2** | **U24CI212X.2** | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 1 |
| **CO3** | **U24CI212X.3** | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 1 |
| **CO4** | **U24CI212X.4** | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 1 | 1 |
| **CO5** | **U24CI212X.5** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 |
| **CO6** | **U24CI212X.6** | 2 | 2 | 2 | 1 | 2 | 1 | - | 2 | 1 | 2 | 1 | 1 | 1 |
| **CO7** | **U24CI212X.7** | 2 | 2 | 2 | 1 | 2 | 1 | - | 2 | 1 | 2 | 1 | 1 | 1 |
| **CO8** | **U24CI212X.8** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 |
| **U24CI212X** | | **2** | **2** | **1. 75** | **1** | **1.5** | **1** | **1** | **2** | **1** | **2** | **1** | **1** | **1** |

3 – HIGH, 2 – MEDIUM, 1 - LOW

# OPERATIONAL AMPLIFIERS AND APPLICATIONS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II –Semester(Exit) | | **Branch:** ECIE | |
| **Course Code:** | **U24CI213X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE :** | **60%** |
| **Total Number of Teaching Hours:** | **32 Hrs** | **ESE :** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** building blocks and characteristics of Op-Amp
**LO2:** linear applications of Op-Amp
**LO3:** non-linear applications of Op-Amp
**LO4:** designing of active filters using Op-Amp

**THEORY COMPONENT**

**UNIT-I** — **4 Hrs**

**Integrated circuits (ICs):** Introduction, Classification of ICs
**Operational Amplifier (Op-Amp):** Building blocks of Op-Amp, Analysis of basic inverting & non-inverting amplifier configurations
**DC & AC Characteristics of Op-Amp:** DC Characteristics: Input offset voltage, Input bias current; Input offset current, Total output offset voltage, Thermal drift, Supply voltage rejection ratio (SVRR), Common mode rejection ratio (CMRR); AC Characteristics: Open loop and closed loop frequency response, Stability of Op-Amp, Slew rate, Ideal and practical characteristics of Op-Amp IC μA 741

**UNIT-II** — **4 Hrs**

**Linear Applications of Op-Amp:** Summing and difference amplifiers, Integrator, Differentiator, Voltage to Current converter, Current to Voltage converter, Instrumentation amplifier, Sample and hold circuit

**UNIT-III** — **4 Hrs**

**Non-linear Applications Op-Amp:** Precision rectifiers–half and full wave rectifiers, Log amplifier
**Comparators and Waveform Generators:** Op-Amp comparator, Regenerative comparator (Schmitt Trigger), and Wien's bridge oscillator

**UNIT-IV** — **4 Hrs**

**Active filters:** Introduction, Ideal and realistic frequency responses of various filters, Analysis and design of first order filters: Low pass, High pass, Band pass and Band stop, IGMF general configuration

**LABORATORY COMPONENT**

**List of Experiments**

1. Measurement of static and dynamic parameters of Op-Amp IC 741
2. Design and testing of Adder and Subtractor circuits using IC 741
3. Design and testing of differentiator using Op-Amp IC 741
4. Design and testing of integrator using Op-Amp IC 741
5. Design and testing of Instrumentation amplifier using Op-Amp IC 741
6. Design and testing of Precision rectifier using Op-Amp IC 741
7. Design and testing of log amplifier using Op-Amp IC 741
8. Design of a Wien's bridge oscillator for specified frequency using Op-Amp IC 741
9. Design and testing of first order active low pass filter using Op-Amp IC 741
10. Design and testing of first order active high pass filter using Op-Amp IC 741

**Textbook(s):**

1. D. Roy Choudhury and Shail B Jain, *Linear Integrated Circuits*, New Age International, New Delhi, 4th edition, 2010

**Reference Book(s):**

1. Ramakant Gayakwad, *Op-Amps and Linear Integrated Circuits*, Pearson Education, New Delhi, 4th edition, 2015
2. George B. Clayton, *Linear Integrated Circuits and Applications*, The Macmillan Press Ltd., London, 1975
3. Rodert F. Coughlin and Frederick F. Driscoll, *Operational Amplifiers and Linear Integrated Circuits*, Pearson Education, New Delhi, 6th edition, 2000
4. S. Salivahanan and V S Kanchana Bhaaskaran, *Linear Integrated Circuits*, McGraw Hill Education (India) Pvt. Ltd., Chennai, 3rd edition, 2019

**Web and Video link(s):**

https://onlinecourses.nptel.ac.in/noc23_ee65/preview; *NPTEL Video Lecture on Op-amp practical application: Design, Simulation and Implementation by Prof. Hardik J Pandya, Department of Electronic Systems Engineering, IISc Bangalore.*

**Laboratory Manual (for laboratory component):**

1. *Linear and Digital Integrated Circuits Laboratory Manual*, Department of ECIE, KITSW

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1:** analyze characteristics of Op-Amp IC741 using fundamental concepts

**CO2:** design Op-Amp based linear circuits for the given specifications

**CO3:** design Op-Amp based non-linear circuits for the given specifications

**CO4:** design Op-Amp based active filters for the given specifications

*(based on psychomotor skills acquired from laboratory component)*

**CO5:** measure the static and dynamic parameters of Op-Amp IC741

**CO6:** design Op-Amp based circuits for linear application adder, subtractor, differentiator, and integrator

**CO7:** design Op-Amp based circuits for non-linear application precision rectifiers, log amplifier, and oscillators

**CO8:** design and test the performance of IC 741 based active filters

| **Course Articulation Matrix (CAM):** | | **U24CI213X OPERATIONAL AMPLIFIERS AND APPLICATIONS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI213X.1** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO2** | **U24CI213X.2** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO3** | **U24CI213X.3** | 2 | 2 | - | - | - | - | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO4** | **U24CI213X.4** | 2 | 2 | - | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO5** | **U24CI213X.5** | 2 | 2 | 1 | - | - | - | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| **CO6** | **U24CI213X.6** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| **CO7** | **U24CI213X.7** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| **CO8** | **U24CI213X.8** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 |
| **U24CI213X** | | **2** | **2** | **1** | **1** | **1** | **1** | **1** | **1** | **1.5** | **1** | **1** | **1.5** | **1.5** |

3 – HIGH, 2 – MEDIUM, 1 – LOW

# COMMUNICATION SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. II –Semester(Exit) | | **Branch:** ECIE | |
| **Course Code:** | **U24CI214X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **32 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

***LO1:*** classification of signals and Fourier Series
***LO2:*** Fourier Transform and Amplitude modulation techniques
***LO3:*** generation of frequency and pulse modulated signals
***LO4:*** types of digital modulation schemes

**THEORY COMPONENT**

| **UNIT-I** | **4 Hrs** |
|---|---|

**Signals and systems:** Overview of electronic communication systems, classification of signals, unit impulse, step, ramp and exponential signals, signal operations, convolution and correlation, Fourier series expansion, Fourier series properties, Sampling theorem, Response of a linear system in time domain

| **UNIT-II** | **4 Hrs** |
|---|---|

**Fourier Transform:** Fourier transform, Fourier transform of standard signals, Fourier transform properties, System response in frequency domain

**Amplitude Modulation Systems (Qualitative):** Need for frequency translation, Double side band- Supressed carrier (DSB-SC) modulation, Amplitude modulation (AM)- Double side band- with Carrier (DSB-C), Single side band modulation (SSB)

| **UNIT-III** | **4 Hrs** |
|---|---|

**Angle Modulation (Qualitative):** Types of angle modulation (Frequency modulation and Phase modulation), Modulation index, Comparison of AM, FM and PM

**Pulse Modulation (Qualitative):** Analog and digital signals, analog and digital communication techniques, Block diagram of digital communication system, Pulse modulation techniques - PAM, PWM and PPM waveforms, Generation and demodulation of PAM, PWM and PPM, Comparison of pulse modulation techniques, Generation and demodulation of PCM signal, Delta modulation

| **UNIT-IV** | **4 Hrs** |
|---|---|

**Digital Modulation (Qualitative):** Need for digital modulation, Bit rate and baud rate, Types of digital modulation techniques- ASK, FSK and PSK, Comparison of ASK, FSK and PSK, Applications of different digital modulation techniques

**LABORATORY COMPONENT**

**List of Experiments**

1. Generation of AM Signal, find the modulation index and percentage of modulation with different modulation signals
2. Generation of DSB-SC Signal, find the modulation index and percentage of modulation with different modulation signals
3. Determination of modulation index and frequency deviation of FM signal
4. Generation and demodulation of Analog pulse modulation signals
   - 4.1.1 Pulse amplitude modulation
   - 4.1.2 Pulse width modulation
   - 4.1.3 Pulse position modulation

5. Interpretation of modulated and demodulated waveforms of a PCM system for different sampling frequencies
6. Delta modulation & demodulation
   - 6.1 Adaptive delta modulation and demodulation
   - 6.2 Sigma delta modulation and demodulation
7. Digital modulation techniques
   - 7.1 Amplitude shift keying
   - 7.2 Phase shift keying
   - 7.3 Frequency shift keying
8. Generate - Unit step, Ramp, Impulse, Exponential and sinusoidal signals using MATLAB
9. Perform scaling, shifting and delay operations on signals using MATLAB
10. Perform the correlation and convolution of two sequences using MATLAB
11. MATLAB implementation of Amplitude modulation
12. MATLAB implementation of Frequency modulation

**Textbook(s):**

1. Herbart Taub, Donald L Schilling, *Principles of Communication Systems*, 3rd edition, Tata McGraw-Hill, New Delhi, 2007

**Reference Book(S):**

1. R. P. Singh and S. D. Sapre, *Communication Systems (Analog and Digital),* 2nd edition, McGraw-Hill, New Delhi, 2008
2. Simon Haykin and Michael Moher, *Introduction to Analog and Digital Communications*, 2nd edition, John Wiley & Sons, USA, 2007
3. B.P. Lathi, Zhi Ding, *Modern digital and analog communication systems,* 5th edition, Oxford University Press, USA, 2019
4. K. Sam Shanmugam, *Digital and Analog Communication Systems*, John Wiley & Sons, New Delhi, 2008

**Web and Video link(s):**

NPTEL :: Electrical Engineering - NOC:Principles of Communication Systems - I; *NPTEL Video Lectures on principles of communication systems-1 by* Prof. Aditya K. Jagannatham, IIT Kanpur.

**Laboratory Manual (for laboratory component):**

2. *Communication Systems Laboratory Manual and Record Book,* Department of ECIE, KITSW

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to…,*

*(based on cognitive skills acquired from theory component)*

**CO1:** apply basic operations on signals and estimate the response of a system
**CO2:** analyze different amplitude modulation techniques
**CO3:** distinguish different pulse modulation schemes
**CO4**: compare different digital modulation techniques

*(based on psychomotor skills acquired from laboratory component)*

**CO5** : determine the modulation index and percentage modulation of an AM carrier
**CO6** : determine the modulation index and measure the frequency deviation of an FM signal
**CO7** : develop MATLAB code to generate AM & FM modulated signals
**CO8** : measure amplitude, frequency and phase in different shift keying techniques

| Course Articulation Matrix (CAM): | | U24CI214X COMMUNICATION SYSTEMS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CI214X.1 | 1 | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 |
| CO2 | U24CI214X.2 | 1 | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 |
| CO3 | U24CI214X.3 | 1 | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 |
| CO4 | U24CI214X.4 | 1 | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 |
| CO5 | U24CI214X.5 | 1 | 1 | 1 | - | 2 | - | 1 | 2 | 1 | - | 1 | 1 | 1 |
| CO6 | U24CI214X.6 | 1 | 1 | 1 | - | 2 | - | 1 | 2 | 1 | - | 1 | 1 | 1 |
| CO7 | U24CI214X.7 | 1 | 1 | 1 | - | 2 | - | 1 | 2 | 1 | - | 1 | 1 | 1 |
| CO8 | U24CI214X.8 | 1 | 1 | 1 | - | 2 | - | 1 | 2 | 1 | - | 1 | 1 | 1 |
| U24CI214X | | **1** | **1** | **1** | **0** | **1.5** | - | **1** | **1** | **1** | **0** | **1** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तैलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశం
KITSW Estd. 1980
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
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# Semester - III Syllabi

## III SEMESTER

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | O | E | C |
| 1 | BSC | U24MH301C | Mathematical foundations for Signal Processing | 2 | 1 | - | 6 | 9 | 3 |
| 2 | PCC | U24CI302 | Sensors and Actuators | 2 | 1 | 2 | 5 | 10 | 4 |
| 3 | PCC | U24CI303 | Analog Integrated Circuits and Applications | 2 | 1 | 2 | 5 | 10 | 4 |
| 4 | PCC | U24CI304 | Digital Circuits and Logic Design | 2 | 1 | - | 4 | 7 | 3 |
| 5 | ESC | U24CI305 | OOP through Java | 2 | 1 | 2 | 5 | 10 | 4 |
| 6 | VAC | U24VA306A | Quantitative Aptitude and Logical Reasoning@ | 2 | | - | 2 | 4 | 2 |
| 7 | SEC | U24SE307 | Programming Skill Development Lab – 2(DSC) | - | - | 2 | 2 | 4 | 1 |
| 8 | ELC | U24EL308 | Practicum-3 | - | - | - | 4 | 4 | 1 |
| 9 | VAC | U24VA309X XXXX | SEA-3 / SAA -3 | - | - | - | 2 | 2 | 1 |
| 10 | AEC | U24AE310 | Expert Talk Series-3 | - | - | - | 1 | 1 | 1 |
| | | | Total: | 12 | 5 | 8 | 36 | 61 | 24 |
| Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean,AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet) | | | | - | - | - | - | - | - |

| Branch Specific Mathematics (Pool-4) | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| **1.** | U24MH301A | Numerical and Statistical Methods ***(for Civil Engineering)*** |
| **2.** | U24MH301B | Applied Mathematics ***(for Mechanical Engineering)*** |
| **3.** | U24MH301C | Mathematical foundations for Signal Processing ***(for ECI)*** |
| **4.** | U24MH301D | Discrete Mathematics and Probability Statistics ***(Common to CSE, CSN, CSO & IT)*** |
| **5.** | U24MH301E | Essential Mathematics and Statistics for Machine learning ***(for CSM)*** |
| **6.** | U24MH301F | Essential Mathematics and Statistics for Data science ***(for CSD)*** |

| @U24VA306 T & P Basket | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| **1.** | U24VA306A | Quantitative Aptitude and Logical Reasoning ***(for Stream I)*** |
| **2.** | U24VA306B | Soft and Interpersonal Skills ***(for Stream II)*** |

# MATHEMATICAL FOUNDATIONS FOR SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| **Class: B.Tech. III -Semester** | | **Branch:** ECIE | |
| **Course Code:** | **U24MH301C** | **Credits:** | **3** |
| **Hours/Week(L-T-P-O-E):** | **2-1-0-6-9** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

LO1:continuous-time (CT) and discrete-Time (DT) signals & systems and convolution

LO2: Fourier series representation of periodic signals

LO3: continuous-time Fourier transforms and analysis of LTI systems

LO4: Laplace transform, inverse and circuit analysis

| **UNIT-I** | **9 Hrs** |
|---|---|

**Signals and Systems**: Continuous-time (CT),sampling theorem(statement only), discrete-time (DT) signals, transformations of independent variable, Elementary Signals -Unit Step function, Unit Ramp function, Unit impulse function, exponential and sinusoidal signals, CT & DT systems, Basic system properties

**Linear Time–Invariant (LTI) Systems:** DT-LTI systems-representation of DT signals in terms of impulses, DT unit impulse response and the Convolution sum representation of LTI systems; CT-LTI systems- representation of CT signals in terms of impulses, CT unit impulse response and the Convolution integral representation of LTI systems; Properties of LTI systems, LTI systems described by differential and difference equations

***Self-Learning Topics (SLTs):*** *Signal addition, Signal multiplication [Ref1: topic 1.4.5, topic 1.4.6], Solved problems:[Text1: Examples 1.1, 1.2,:2.2,2.3,2.6.2.7],Practice problems: [Text1: Problems 2.1 to .5,2.22,2.28.2.29]*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Continuous Time Fourier Series(CTFS) :** Introduction **,** Response of LTI systems to complex exponentials, Linear combination of harmonically related complex exponentials ,Determination of the CTFS representation of periodic signals , Fourier spectrum, Convergence of CTFS, Properties of CTFS, Parseval's relation for CT periodic signals

**Discrete-Time Fourier Series (DTFS):** Fourier series representation of DT periodic signals, Properties of DTFS, Fourier series and LTI systems

***Self-Learning Topics(SLTs):*** *Trigonometric Fourier series from exponential Fourier series, Cosine Fourier Series from Exponential Fourier Series, [Ref1: topic4.7.2, 4.7.3], Solved problems:[Text1:Examples 3.3 to 3.5], Practice problems:[Text1:Problems: 3.1 to 3.4, 3.22, 3.31]*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Continuous Time Fourier Transform (CTFT) :** Fourier transform representation of CT Aperiodic signals , Convergence of CTFT , Magnitude and phase representation of Fourier transform, CTFT for periodic signals , Properties of CTFT , Parseval's relation, Systems characterized by linear constant–coefficient differential equations (LCCDE)

**Discrete Time Fourier Transform (DTFT) :** Fourier transform representation of DT Aperiodic signals , DTFT

Convergence, DTFT for periodic signals, Properties of DTFT , Systems characterized by linear constant–coefficient difference equations (LCCDE)

***Self-Learning Topics(SLTs):*** *Fourier transforms of Triangular pulse, Cosine wave, Sine wave [Ref1: topic5.5.9,5.5.10,5.5.11,5.6.15],Solved problems:[ Text1: Examples 4.15, 4.22, 4.25,Ref1 5.5.9, 5.5.10, 5.5.11, 5.6.15].Practice problems: [Text1 Problems:4.1,4.2,4.6,4.23]*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Laplace Transforms:** Introduction, Region of convergence, Properties, Analysis and characterization of LTI systems using Laplace transforms, Systems characterized by linear constant–coefficient differential equations (LCCDE), Inverse Laplace transforms, Block diagram representation of causal LTI systems

**Circuit analysis using Laplace transform**: Step and impulse responses of series R-L, R-C & R-L-C circuits

***Self-Learning Topics (SLTs):*** *Hyperbolic sine and cosine functions, Damped sine and cosine functions, Damped hyperbolic sine and cosine functions [Ref 1: topic 9.6.8, 9.6.9, 9.6.10] ,Solved problems: [Text19.14,9.15,9.23,9.24,9.25 ,Ref1 9.6.8,9.6.9,9.6.10],Practice problems:[Text1 : 9.17, 9.18,9.22,Ref: Exercise9:Problems:1,7,10,11]*

**Course Learning Outcomes (COs):***After completion of this course, the students should be able to….*

**CO1:** classify CT and DT signals & systems and perform convolution for finding response of an LTI system to any arbitrary signal

**CO2:** determine the CTFS and DTFS representation of periodic signals and plot the frequency spectrum

**CO3:** evaluate CTF of standard signals and apply properties of CTFT for characterizing systems defined by LCCDE

**CO4:** compute Laplace Transform of standard signals and apply the properties of Laplace transforms for circuit analysis

Textbook(s):

1. Alan Oppenheim and Alan S.Willsky with S. Hamid Nawab, *Signals & Systems*, 2nd ed., New Delhi: Prentice Hall of India, 2010. (Chapters 1, 2, 3, 4,5,9)

Reference Books:

1. A. Anand Kumar, *Signals and Systems*, 3rd ed., New Delhi: PHI, 2013.
2. Simon Haykin and Barry Van Veen, *Signals & Systems*, 2nd ed., Wiley India , 2008.
3. B.P.Lathi, *Signals Systems and Communication*, BS Publications, 2003.

Web and Video link(s):

1. https://archive.nptel.ac.in/courses/108/106/108106163/:NPTEL Video lecture on Signals and Systems by Prof. Kushal K. Shah, Department of Electrical Engineering& computer science/IISER Bhopal
2. https://archive.nptel.ac.in/courses/108/104/108104100/: NPTEL Video Lecture on Principles of Signals and Systems by Prof. Aditya k. Jagannatham, Department of Electrical Engineering/ IIT Kanpur

| Course Articulation Matrix (CAM): | | U24MH301C:MATHEMATICAL FOUNDATIONS FOR SIGNAL PROCESSING | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24MH301C.1 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 2 | 2 |
| CO2 | U24MH301C.2 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 2 | 2 |
| CO3 | U24MH301C.3 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 2 | 2 |
| CO4 | U24MH301C.4 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 2 | 2 |
| U24MH301C | | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 1 | 2 | 2 |

## SENSORS AND ACTUATORS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester | | **Branch: ECIE** | |
| **Course Code:** | **U24CI302** | **Credits:** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40%** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1**: classification of sensors & actuators and transduction principles of pressure sensors
**LO2**: transduction principles of level & flow sensors
**LO3**: working principle of mechanical energy based and Magnetic field based sensors & actuators
**LO4**: working principle of electric field based sensors & actuators and working principle smart sensors & transmitters

### THEORY COMPONENT

| UNIT-I | 9 Hrs |
|---|---|

**Sensors and Actuators**: Importance of sensors and actuators, Domain of physical phenomena, Classification of sensors and actuators, Importance of 4-20mA signal transmission in industrial applications

**Pressure Sensors:** Manometers; Elastic Transducers - Thin plate diaphragms, Bellows, Bourdon tube; Mcleod gauge, Pirani thermal conductivity gauge, Ionization gauge

***Self Learning Topics (SLTs):*** *Dead weight tester(Text1: topic 11.4.2), Practice problems (Text1: Prob 11.5 to 11.8), Practice problems (Text1:Prob17.4)*

| UNIT-II | 9 Hrs |
|---|---|

**Level Sensors:** Float gauges, Purge method, Buoyancy method; Level Probes - Resistive, Capacitive and Inductive types; Ultrasonic level gauge, Nucleonic level gauge, RF based level sensor

**Flow Sensors:** Flow sensors classification, Variable head meters, Variable area meter, Pitot-static tube, Differential pressure transmitter (DPT), Turbine flow meter, Ultrasonic flow meter, Electromagnetic flow meter, Hot wire anemometer

**Miscellaneous sensors:** Hydrometer, Viscosity sensor, pH sensor, Humidity sensor

***Self Learning Topics (SLTs):*** *Laser doppler anemometer (Text1: topic 13.6.2), Practice problems (Text1: 13.5 to 13.12)*

| UNIT-III | 9 Hrs |
|---|---|

**Mechanical Energy based Sensors and Actuators:** Piezoelectric accelerometer; Fluid actuators- Pneumatic actuators, Hydraulic actuators

**Magnetic field based Sensors and Actuators:** Hall effect sensor, Magnetostrictive torque sensor, Servo motor, Stepper motor, Electromagnetic relay, Solenoid

***Self Learning Topics (SLTs):*** *Angular displacement sensor (Text2: topic 3.4.1)*

| UNIT-IV | 9 Hrs |
|---|---|

**Electric field based Sensors and Actuators:** Capacitive acceleration sensor, Angular velocity sensor (Gyroscope), Capacitive fingerprint sensor, Electrostatic loudspeaker, Electrostatic

MEMS actuator

**Smart Sensors and Transmitters:** Micro sensors, Smart sensors, IC based sensors, I-P and P-I converters, 4-20 mA two-wire transmitter, Importance of P&I diagrams in industry applications

***Self Learning Topics (SLTs):*** *Micro & nanotechnology (Text2: topic 2.2.2 to 2.2.5), Smart transmitters and field bus (Text1: topic 18.3,18.4), Practice problems (Text1: Prob 18.1)*

**LABORATORY COMPONENT**

**List of Experiments**

1. Basic Programming in LabVIEW
2. Programs on Sub VI's and Repetition and Loops
3. Programs on Arrays and Matrices
4. Programs on Strings, File I/O
5. Reading and writing an analog signal using NI-DAQ device
6. Strain measurement using NI DAQ and LabVIEW
7. Distance measurement using NI DAQ and LabVIEW
8. Acceleration measurement using NI DAQ and LabVIEW
9. Level measurement using NI DAQ and LabVIEW
10. Temperature measurement and control using NI DAQ and LabVIEW
11. Speed control using NI DAQ and LabVIEW
12. Pressure measurement using NI DAQ and LabVIEW

**Textbook(s):**


2. B C Nakra (Late) & K K Chaudhry, "*Instrumentation, Measurement and Analysis*", 4th ed. New Delhi, McGraw Hill Education (India) Pvt. Ltd.,2017. *(Chapters 11,13,17&18)*
3. Francisco André Corrêa Alegria," *Sensors and Actuators",* World Scientific Publishing Co. Pte. Ltd., 2022. *(Chapters 1,2,3,5,6 &12)*


**Reference Books:**


1. D.V.S. Murthy, "*Transducers and Instrumentation",* Prentice Hall of India, 2nd ed., New Delhi, 2012.
2. Franklyn W. Kirk &Thomas A. Weedon Philip Kirk *"Instrumentation and Process Control"*, American Technical Publishers Inc. USA, 6th ed., 2014.
3. B.G. Liptak, "*Process Measurement and Analysis - Instrument Engineers' Hand Book*", CRC press, 4th ed., 2003.
4. Alok Barua, "*Fundamentals of Industrial Instrumentation*", Iop Publishing Ltd.,2nd ed., 2024.


*Web and Video link(s):*

1. https://archive.nptel.ac.in/courses/108/105/108105064/;*Industrial Instrumentation by*

*Prof.AlokBarua, Professor of EEE, IIT Kharagpur*

**Laboratory Manual (for laboratory component):**

1. *Sensors and Actuators Laboratory Manual,* Department of ECIE, KITSW.

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1**:classify different types of sensors & actuators based on the physical phenomena and select pressure sensors for industrial measurement applications

**CO2:** select level & flow sensors for industrial measurement applications

**CO3**: illustrate the sensing & actuation principles of mechanical energy based & magnetic field based devices

**CO4**: illustrate the sensing & actuation principles of electric field based devices and make use of smart sensors, transmitters, P&I diagrams for industrial applications

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: interface distance sensors with NI DAQ hardware for accurate signal acquisition

**CO6:** acquire skills in interfacing distance sensors with NI DAQ hardware

**CO7:** apply learned concepts to real-world industrial temperature monitoring and control scenarios

**CO8:** analyze distance data and interpret measurement trends effectively

| **Course Articulation Matrix (CAM):** | | **U24CI302: SENSORS AND ACTUATORS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI302.1** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO2** | **U24CI302.2** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO3** | **U24CI302.3** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO4** | **U24CI302.4** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO5** | **U24CI302.5** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **CO6** | **U24CI302.6** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **CO7** | **U24CI302.7** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **CO8** | **U24CI302.8** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **U24CI302** | | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 1.5 | 1 | 1 | 2 | 2 |

# ANALOG INTEGRATED CIRCUITS AND APPLICATIONS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI303** | **Credits:** | **4** |
| **Hours / Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** principles, characteristics, and building blocks of operational amplifier (Op-Amp)
**LO2:** linear and non-linear applications of operational amplifiers
**LO3:** active filters using Op-Amps and operation of IC 555 timer & its applications
**LO4:** operation of phase locked loop, voltage regulators and data converters

**THEORY COMPONENT**

**UNIT-I** **9 Hrs**

**Integrated Circuits (ICs):** Introduction, Classification of ICs

**Operational Amplifier (Op-Amp):** Building blocks of Op-Amp, Analysis of basic inverting and non-inverting amplifier configurations, Voltage follower

**DC & AC Characteristics of Op-Amp:** DC Characteristics: Input offset voltage, Input bias current; Input offset current, Total output offset voltage, Thermal drift, Supply voltage rejection ratio (SVRR), Common mode rejection ratio (CMRR); AC Characteristics: Open loop and closed loop frequency response, Stability of Op-Amp, Slew rate, Ideal and practical characteristics of Op-Amp IC μA 741

***Self-Learning Topics (SLTs):*** *Fabrication process of IC (Text1: topic 1.6), Differential amplifiers - balanced & unbalanced (Text1: topics 2.4), Practice problems (Text2: Problems 2.6 to 2.14)*

**UNIT-II** **9 Hrs**

**Linear Applications of Op-Amp:** Summing and difference amplifiers, Integrator, Differentiator, Voltage to current converter, Current to voltage converter, Instrumentation amplifier, Sample and hold circuit

**Non-linear Applications Op-Amp:** Precision rectifiers–half and full wave rectifiers, Logarithmic amplifier

**Comparators and Waveform Generators:** Op-Amp comparator, Regenerative comparator (Schmitt Trigger), and Wien's bridge oscillator

***Self-Learning Topics (SLTs):*** *Anti-log amplifier (Text1: topic 4.8), Solved problems (Text1: Problems 4.14)*

**UNIT-III** **9 Hrs**

**Active Filters:** Introduction, Ideal and realistic frequency responses of various filters, Analysis and design of first order filters: Low pass, High pass, Band pass and Band stop, IGMF general configuration

**IC 555 Timer:** Introduction, Functional diagram, Design of astable and monostable multivibrators using 555timer, Applications of astable multivibrator - FSK generator, Pulse position modulation, Schmitt trigger; Applications of monostable multivibrator - Linear ramp generator

***Self-Learning Topics (SLTs):*** *Second order low & high pass filters (Text1: topic 7.2), Applications of IC 555 Timer: Missing pulse detector, Pulse-width modulation (Text1: topics 8.3, 8.4), Solved problems (Text1: Prob 8.5)*

**UNIT-IV** **9 Hrs**

**Voltage Regulators:** Basic voltage regulator using Op-Amps, General purpose IC regulator, µA723 - Functional diagram, Specifications, Three terminal voltage (fixed) regulators- General features and IC series of three terminal regulators

**Data Converters:** DAC types – Weighted resistor, R-2R ladder; ADC types - Flash, Successive approximation and Dual slope

**Phase Locked Loops (PLLs) (Qualitative treatment only):** Voltage controlled oscillator, Basic PLL operation, Definitions related to PLL, PLL application – FSK and AM detectors

**Self-Learning Topics (SLTs):** *Design of low & high voltage regulators (Text1: topics 6.2, 6.3), Weighted resistor (Text1: topics 10.2)*

**LABORATORY COMPONENT**

**List of Experiments**

1. V-I characteristics of P-N junction diode and Zener diode
2. Diode rectifiers without & with C, L and Π filters
3. I/O Characteristics of BJT in Common Emitter (CE) Configuration
4. Design and testing of single stage RC coupled amplifier
5. Design and testing of voltage series feedback amplifier using BJT
6. Design and testing of RC phase shift oscillator using BJT
7. Design and testing of Adder and Subtractor circuits using IC 741
8. Design and testing of differentiator using IC 741
9. Design and testing of integrator using IC 741
10. Design and testing of Wien's bridge oscillator using IC 741
11. Design and testing of astable multivibrator using IC 555
12. Design and testing of second order active low pass filter using IC 741

**Textbook(s):**

1. D. Roy Choudhury and Shail B Jain, *Linear Integrated Circuits*, 4th ed., New Delhi: New Age International, 2010.

**Reference Book(s):**

6. Ramakant Gayakwad, *Op-Amps and Linear Integrated Circuits*, 4th ed., New Delhi: Pearson Education, 2015.
7. George B. Clayton, *Linear Integrated Circuits and Applications*, London: The Macmillan Press Ltd., 1975.
8. Rodert F. Coughlin and Frederick F. Driscoll, *Operational Amplifiers and Linear Integrated Circuits*, 6th ed., New Delhi: Pearson Education, 2000.
9. S. Salivahanan and V S Kanchana Bhaskaran, *Linear Integrated Circuits*, 3rd ed., Chennai: McGraw Hill Education (India) Pvt. Ltd., 2019.

**Web and Video link(s):**

https://onlinecourses.nptel.ac.in/noc23_ee65/preview; *NPTEL Video Lecture on Op-amp practical application: Design, Simulation and Implementation by Prof. Hardik J Pandya, Department of Electronic Systems Engineering, IISc Bangalore.*

**Laboratory Manual (for laboratory component):**

2. *Analog Integrated Circuits and Applications Laboratory Manual and Record Book*, Department

of ECIE, KITSW

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1:** analyze performance characteristics of Op-Amp IC 741
**CO2:** design Op-amp based linear & non-linear circuits
**CO3:** analyze the frequency response of Op-amp based active filters
**CO4:** design IC 723 based voltage regulators and data converters

*(based on psychomotor skills acquired from laboratory component)*

**CO5:** analyze the V-I characteristics of diodes and design rectifier circuits without & with filters
**CO6:** design and test the functionality of BJT amplifiers and oscillators
**CO7:** design and test the functionality of Op-Amp circuits such as adders, subtractors, differentiators & integrators
**CO8:** design and test the functionality of oscillators & multivibrators

| **Course Articulation Matrix (CAM):** | | **U24CI303 ANALOG INTEGRATED CIRCUITS AND APPLICATIONS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI303.1** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO2** | **U24CI303.2** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO3** | **U24CI303.3** | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO4** | **U24CI303.4** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO5** | **U24CI303.5** | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **CO6** | **U24CI303.6** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **CO7** | **U24CI303.7** | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **CO8** | **U24CI303.8** | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **U24CI303** | | **2** | **2** | **1** | **1** | **1.5** | **1.5** | **1** | **1.5** | **1.5** | **1** | **1** | **1.5** | **1.5** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# DIGITAL CIRCUITS AND LOGIC DESIGN

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester | | **Branch:** ECIE | |
| **Course Code:** | **U24CI304** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-1-0-4-7** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** number systems, binary codes, Boolean algebra and minimization techniques
**LO2:** design and implementation of combinational circuits
**LO3:** analysis and design of sequential circuits
**LO4:** PLDs and operation of logic families

| **UNIT-I** | **9 Hrs** |
|---|---|

**Number Systems and Codes:** Number systems-representation, Conversion, Binary arithmetic, 1's and 2's complement subtraction; Binary Codes-Weighted binary codes, Self-complementing codes, Non-weighted Codes

**Boolean Algebra and Minimization**: Boolean algebra- Postulates and theorems, Logic gates, minimization and realization of switching functions ; Standard SOP & POS forms, Karnaugh maps-minimization of three and four variable functions, Quine–McClusky technique- Minimization of four and five variable functions

***Self Learning Topics (SLTs) :****Binary representation of signed numbers (Text1: topics 1.6), Error correction and detection (Text1: topics 3.9 ,7.4),Practice problems (Text1: Example 2.2, 2.3 )*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Combinational circuits:** Half adder, Full adder, Half subtractor, Full subtractor, Parallel adder, Serial adder, Carry look ahead adder, BCD adder, Decoders, Encoders, Priority encoders, Multiplexers, Demultiplexers, Realization of switching functions using multiplexers and decoders

***Self Learning Topics (SLTs):*** *- 1's & 2's complement adder/subtractor (Text1: topics 4.5),BCD to 7 segment decoder and code converters (Text1: topics 4.4), parity generators (Text1: topics 3.8),comparators (Text1: topics 4.8)*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Sequential circuits:** Flip flops -SR, JK, D and T, Direct inputs, Race around condition , Master slave flip flop ; Binary counters – Design of asynchronous (ripple) and synchronous counters; Shift registers – Modes of operation, Ring and Johnson counters

**Synchronous sequential circuits:** State table, State diagram, State assignment, Design of synchronous sequential circuits - Counters , Sequence detectors

***Self Learning Topics (SLTs) :*** *Conversion of one flip flop to other (Text1: topics 5.4),bidirectional and universal Shift register (Text1: topics 6.2)*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Programmable logic devices (PLDS):** Introduction to PLDs, Read only memories (ROMs), Programmable logic array devices (PLAs), Programmable array logic devices (PALs), Implementation
of Boolean functions on PLDs

**Logic families** : Introduction to logic families, Characteristics, Study of RTL, TTL, ECL and MOS families (Qualitative analysis)

***Self Learning Topics (SLTs):*** *MOS structure (Text1: topics 10.7), Combinational circuit implementation (Ref.3: topic 8.4), Solved problems on ROM implementation (Ref.3: Example 8.1, 8.2, 8.3).*

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1**: apply Boolean algebra, K-Maps and QM method to minimize logic functions
**CO2**: design combinational circuits using logic gates
**CO3**: design synchronous sequential circuits using flip-flops
**CO4**: design logic circuits using PLDs and analyze transfer characteristics of logic families

**Textbook(s):**

1. M. Morris Mano, *Digital Design*, 5th ed., New Delhi: PHI, 2013.

**Reference Books:**

1. Zvi Kohavi, *Switching and Finite Automata Theory*, 2nd ed., New Delhi: Tata McGraw-Hill, 2008.
2. R.P. Jain, *Modern Digital Electronics*, 3rd ed., New Delhi: Tata Mc Graw-Hill,2003.
3. A. Anand Kumar, *Fundamentals of Digital Circuits*, ,3rd ed., New Delhi: PHI, 2014.
4. Herbert Taub and Donald Schilling, *Digital Integrated Circuits*, New Delhi: Tata McGraw-Hill, 2008.

**Web and Video link(s):**

1. https://www.youtube.com/watch?v=yLP0vFSbCLg ; *NPTEL Video Lecture on Number Systems*
2. https://www.youtube.com/watch?v=Y5yprWIPDps ; *NPTEL Video Lecture on Binary codes by Prof Chandan Karla ,IIT Guwahati*
3. https://www.youtube.com/watch?v=CeD2L6KbtVM ; *NPTEL Video Lecture on Digital Circuits and Systems by Prof. S. Srinivasan, Professor of Electrical Engineering, IIT, Madras*.

| **Course Articulation Matrix (CAM) :** | | **U24CI304 DIGITAL CIRCUITS AND LOGIC DESIGN** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI304.1** | 2 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 2 | 2 | 2 |
| **CO2** | **U24CI304.2** | 2 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 2 | 2 | 2 |
| **CO3** | **U24CI304.3** | 2 | 2 | 2 | 2 | 1 | 1 | - | 1 | 1 | - | 2 | 2 | 2 |
| **CO4** | **U24CI304.4** | 2 | 2 | 2 | 2 | 1 | 1 | - | 1 | 1 | - | 2 | 2 | 2 |
| **U24CI304** | | **2** | **2** | **1.5** | **1.5** | **1** | **1** | **-** | **1** | **1** | **-** | **2** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# OBJECT ORIENTED PROGRAMMING THROUGH JAVA

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III –Semester | | **Branch:** Common to All | |
| **Course Code:** | **U24CI305** | **Credits:** | **4** |
| **Hours/Week (L-T-P-O-E):** | **2-1-2-5-10** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1**: programming paradigms and java programming constructs
**LO2:** classes, methods and strings
**LO3:** inheritance, dynamic method dispatch, interfaces and packages
**LO4:** exception handling, I/O and multi-threading

**THEORY COMPONENT**

| **UNIT-I** | **9 Hrs** |
|---|---|

**Programming Paradigms:** Procedural programming, Modular programming, Object oriented programming (OOP), Generic programming

**Java Basics:** The History and evolution of Java, An overview of java, Data types, Variables and arrays, Operators, Control statements

**Introducing Classes:** Class fundamentals, Declaring Objects, Object reference variables, Introducing Methods

***Self Learning Topics (SLTs):*** *Lexical Issues like Keywords, identifiers, Literals and comments (TextBook-Chapter 2), Type conversions and casting (TextBook-Chapter 3)*

| **UNIT-II** | **9 Hrs** |
|---|---|

**Classes and Methods**: Overloading methods, *this* keyword, Passing and returning objects, Recursion, Variable length arguments, Constructors, Overloading constructors, Garbage collection, Static variables, Static blocks, Static methods, Nested and inner classes, Command line arguments, Wrapper classes

**Strings:** Exploring String, StringBuffer, StringBuilder and StringTokenizer classes

***Self Learning Topics (SLTs):*** *Overloading Vararg Methods, Varargs and Ambiguity(TextBook-Chapter: 7), Anonymous Inner classes(TextBook-Chapter-25),*

| **UNIT-III** | **9 Hrs** |
|---|---|

**Inheritance:** Inheritance basics, Types of inheritance, Using *super*, Method overriding, Order of constructors Execution, Dynamic method dispatch, Abstract classes, *final* with inheritance, Object class

**Interfaces:** Defining an interface, Implementing interfaces, Nested interfaces, Variables in interfaces, Interfaces can be extended

**Packages:** Defining a package, Packages and Member Access, Importing packages

***Self Learning Topics (SLTs):*** *Accessing Implementations Through Interface References*, *Default interface methods, Use static Methods in an Interface, private interface methods (TextBook-Chapter-9)*

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Using I/O:** I/O basics, Reading, Writing and copying files using byte and character streams

**Exception Handling:** Fundamentals, Exception types, Uncaught exceptions, Using *try* and *catch*, Multiple catch clauses, Nested try statements, *throw*, *throws*, *finally, Creating your own exception sub*

*classes.*

**Multithreading:** Creating a thread, Creating multiple threads, Thread priorities, Synchronization, Interthread communication

***Self Learning Topics (SLTs):*** *try-with resource, multi catch, chained exception, precise re-throw (TextBook-Chapter: 10), Serialization- Writing and reading objects to and from the file-(TextBook-Chapter-22)*

**LABORATORY COMPONENT**

**List of Experiments**

**Experiment-I:**

1. Develop a java program to demonstrate different operators in java.
2. Develop a java program to demonstrate control structures.
3. Develop a java program to demonstrate *switch* statement.

**Experiment-II:**

1. Develop a java program to read an array and display them using *for-each* control. Finally display the sum of array elements.
2. Develop a java program to read a matrix and display whether it is an identity matrix or not. Use *civilizedform* of *break* statement.
3. Develop a java program to define a two dimensional (2D) array where each row contains different numberof columns. Display the 2D-array using *for-each*.

**Experiment-III:**

1. Develop a java program to demonstrate class concept
2. Develop a java program to demonstrate *this*keyword
3. Develop a java program to demonstrate object reference variable
4. Develop a java program to demonstrate overloading of methods
5. Develop a java program to demonstrate passing and returning objects

**Experiment-IV:**

1. Develop a java program to demonstrate variable length argument (using array and ellipsis notation).
2. Develop a java program to demonstrate constructors and garbage collection.
3. Develop a java program to demonstrate nested and inner classes.
4. Develop a java program to demonstrate *static*variables, *static*methods, and*static*blocks.

**Experiment-V:**

1. Read at least five strings from command line argument and display them in sorted order.

2. Develop a java program to demonstrate wrapper class by reading N number of integers from command line and display their sum.

3. Develop a java program to demonstrate wrapper class by reading N floating point numbers from command line and display their average.

**Experiment-VI:**

1. Develop a java program to accept a string, count number of vowels and remove all vowels.

2. Develop a java program to accept a string, count number of vowels and remove all vowels using *StringBuffer*class**.**

3. Develop a java program to accept a line of text, tokenize the line using *StringTokenizer* class and print the tokens in reverse order.

**Experiment-VII:**

1. Develop a java program to demonstrate single level-inheritance.

2. Develop a java program to demonstrate multilevel-inheritance using super.

3. Develop a java program to demonstrate method overriding.

**Experiment-VIII:**

1. Develop a java program to demonstrate dynamic method dispatch.

2. Develop a java program to demonstrate use of abstract class.

3. Develop a java program to demonstrate the use of overriding *equals()* method of an Object class.

**Experiment-IX:**

1. Develop a java program to implement interfaces.

2. Develop a java program to extend the interfaces

3. Develop a java program to demonstrate implementation of nested interfaces.

**Experiment-X:**

1. Develop a java program to create a *package* and demonstrate to import the *package* into any java program (Consider the behavior of all access specifiers).

**Experiment-XI:**

1. Develop a java program to demonstrate *try-catch* block.

2. Develop a java program to demonstrate *throw* clause.

3. Develop a java program to demonstrate *throws* clause.

4. Develop a java program to demonstrate *re-throw* an exception, and *finally* block.

**Experiment-XII:**

1. Develop a java program to demonstrate read/write/copy a file using *byte stream*.
2. Develop a java program to demonstrate read/write/copy a file using *character stream*.
3. Develop a java program to create a thread (using *Thread* class or *Runnable* interface).
4. Develop a java program to demonstrate *synchronization* of threads.
5. Develop a java program to demonstrate *Inter thread communication*.

**Textbook(s):**

1. Herbert Schildt, *Java The Complete Reference*, 13th ed. New Delhi: McGraw Hill, 2024

**Reference Book(s):**

1. Balaguruswamy, *Programming with Java: A Primer*, 7th ed. New Delhi: McGraw Hill, 2023
2. KathySierra and BertBates, *Head First Java*, 2nd ed. Boston: O'Reilly Media, 2005
3. Harvey Deitel and Paul J. Deitel, *Java How to Program,* 11th ed. New Delhi: Pearson, 2018

**Web and Video link(s):**

https://nptel.ac.in/courses/106105191 *NPTEL Video Lecture on Java Programming* by Prof. Debasis Samanta, Professor of CSE, IIT Kharagpur.

**Laboratory Manual (for laboratory component):**

3. *Object Oriented Programming through java Manual and Record Book,* Department of ECIE, KITSW.

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1**: analyze the strengths and limitations of various programming paradigms to determine their suitability for solving various programming problems in java

**CO2**: develop java programs using classes, constructors, methods and various string concepts

**CO3**: apply reusability concepts like inheritance, dynamic method dispatch, interfaces and packages to build java programs

**CO4**: develop java programs using I/O, file handling, exception handling and multithreading concepts

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: develop java fundamental programs using operators, control structures and arrays

**CO6***:* develop java programs using classes, constructors and various string concepts

**CO7***:* build java programs on inheritance, dynamic method dispatch, interfaces and packages

**CO8***:* develop java programs using I/O, exception handling and multithreading concepts

| Course Articulation Matrix (CAM): | | U24CI305: OBJECT ORIENTED PROGRAMMING THROUGH JAVA | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CI305.1 | 2 | 2 | 2 | - | 1 | - | - | - | - | - | 1 | 1 | 1 |
| CO2 | U24CI305.2 | 2 | 2 | 2 | 1 | 2 | - | - | 1 | - | - | 1 | 1 | 1 |
| CO3 | U24CI305.3 | 2 | 2 | 3 | 2 | 1 | - | - | - | - | - | 1 | 1 | 1 |
| CO4 | U24CI305.4 | 2 | 2 | 3 | 2 | 2 | - | - | 1 | - | - | 1 | 1 | 1 |
| CO5 | U24CI305.5 | 1 | 1 | 1 | 1 | 1 | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO6 | U24CI305.6 | 1 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO7 | U24CI305.7 | 1 | 2 | 3 | 2 | 2 | - | - | 1 | 1 | - | 1 | 1 | 1 |
| CO8 | U24CI305.8 | 1 | 2 | 3 | 2 | 2 | - | - | 1 | 1 | - | 1 | 1 | 1 |
| **U24CI305** | | **1.5** | **1.87** | **2.37** | **1.5** | **1.62** | **-** | **-** | **1** | **1** | **-** | **1** | **1** | **1** |

# QUANTITATIVE APTITUDE AND LOGICAL REASONING

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester | | **Branch:** Common to all Branches | |
| **Course Code:** | **U24VA306A** | **Credits:** | **2** |
| **Hours/Week (L-T-P-O-E):** | **2-0-0-2-4** | **CIE** | **60 %** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** quantitative aptitude & problem-solving skills

**LO2**: computation of abstract quantitative information

**LO3**: application of basic mathematics skills & critical thinking to draw conclusions

**LO4:** evaluation of validity & possible biases in arguments presented in authentic contexts

| **UNIT-I** | **6 Hrs** |
|---|---|

**Quantitative Aptitude-I:** Number system, Averages, Percentages, Ratios & proportions, Time, Speed & distance, Time and work

| **UNIT-II** | **6 Hrs** |
|---|---|

**Quantitative Aptitude-II:** Simple interest, Compound interest, Profit & loss, Ages, Permutations & Combinations, Probability

| **UNIT-III** | **6 Hrs** |
|---|---|

**Logical Reasoning-I:** Series completion, Analogy, Coding and decoding, Blood relations, Number, Ranking & Time sequence test, Linear & Circular arrangements

| **UNIT-IV** | **6 Hrs** |
|---|---|

**Logical Reasoning-II:** Data sufficiency, Logical Venn diagram, Syllogisms, Statement & Arguments, Statement & Assumptions, Direction sense test

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: apply arithmetic concepts such as averages, percentages, ratios, and time-based calculations to solve real-life quantitative problems

**CO2**: analyze and solve problems involving financial, arithmetic and probability using structured quantitative methods

**CO3**: identify patterns and apply deductive reasoning to solve series, coding-decoding, and arrangement-based logical problems

**CO4**: evaluate logical statements, assess validity, and draw conclusions using tools like syllogisms, Venn diagrams, and argument analysis

***Note: Students should go through the QALR course supplementary material made available on online learning platform***

- *Contents covered in class shall be practiced through the material available on the online learning platform. At home practice problems and practice tests shall be made available on the online learning platform*
- *Tutorial classes shall be conducted on the online learning platform and hence students shall attend the tutorial classes with laptop/tab*
- *All assessments shall be conducted through online learning platform*

**Textbook(s):**

1. **R S Agarwal**, *Quantitative Aptitude for Competitive Examinations*, 3rd ed., New Delhi: S. Chand Publications, 2019. *(Chapters 1,6,7,8,10,11,12,15,17,21,22,30,31 - for Unit I & II)*

2. **R S Agarwal**, *A Modern Approach to Verbal and Non-Verbal Reasoning*, 3rd ed., New Delhi: S. Chand Publications, 2019. *(Chapters Section I: 1,3,4,5,6,8,16, Section II: 2,3 - for Unit III & IV)*

**Reference Book(s):**

1. **Dinesh Khattar**, *Quantitative Aptitude for Competitive Examinations*, 1st ed., New Delhi: Pearson India, 2019.

2. **Nishit K Sinha**, *Reasoning for Competitive Examinations*, 1 st ed., New Delhi: Pearson India, 2019.

3. **R. N. Thakur**, *General Intelligence and Reasoning*, 1st ed., New Delhi: McGraw Hill Education, 2017.

| **Course Articulation Matrix (CAM):** | | **U24VA306A QUANTITATIVE APTITUDE AND LOGICAL REASONING** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24VA306A .1** | 1 | 2 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| **CO2** | **U24VA306A.2** | 1 | 2 | - | 1 | - | - | - | - | - | - | 1 | 1 | 1 |
| **CO3** | **U24VA306A.3** | - | 1 | - | 2 | - | 2 | - | - | - | - | 1 | 1 | 1 |
| **CO4** | **U24VA306A.4** | - | 1 | - | 2 | - | 2 | - | - | - | - | 1 | 1 | 1 |
| **U24VA306A** | | **1** | **1.5** | **-** | **1.5** | **-** | **2** | **-** | **-** | **-** | **-** | **1** | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PRACTICUM-3

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III-Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24EL308** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-4-4** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** literature review and identifying research gaps

**LO2:** implementing a project independently by applying knowledge to practice

**LO3:** preparing well-documented report and informative PPT

**LO4:** effective technical presentation and creating video pitch

Practicum is an independent project carried out by the student during the course period, under the supervision of allotted course faculty. It helps to reinforce the students' theoretical knowledge and develop their ability to apply this knowledge to the solution of practical problems. Practicums also prepare them for their MINI and MAJOR PROJECTs and for independent work in their chosen field that promotes creative abilities. Besides they provide Higher Order Cognitive Abilities (HOCAs).

(i). Practicum is a mandatory semester project work.

(ii). Practicum is offered as a one credit course. Student has to earn 4 credits (one in each semester from I to IV semesters)

(iii). Allotment of Practicum topics for students:

- **Practicum matrix:** In week (-1), the class teacher, in consultation with HoD, shall prepare the practicum matrix of the section. The practicum matrix is the allotment of group of students to the different course faculty of the section, as shown below.

| Course | U24MH101 | U24PS102 | U24EC103 | U24CS104 | U24EE105 | U24CH106 |
|---|---|---|---|---|---|---|
| Students allotted to different courses | B24XX001 | B24XX011 | B24XX021 | B24XX031 | B24XX041 | B24XX051 |
| | B24XX002 | B24XX012 | B24XX022 | B24XX032 | B24XX042 | B24XX052 |
| | B24XX003 | B24XX013 | B24XX023 | B24XX033 | B24XX043 | B24XX053 |
| | B24XX004 | B24XX014 | B24XX024 | B24XX034 | B24XX044 | B24XX054 |
| | B24XX005 | B24XX015 | B24XX025 | B24XX035 | B24XX045 | B24XX055 |
| | B24XX006 | B24XX016 | B24XX026 | B24XX036 | B24XX046 | B24XX056 |
| | B24XX007 | B24XX017 | B24XX027 | B24XX037 | B24XX047 | B24XX057 |
| | B24XX008 | B24XX018 | B24XX028 | B24XX038 | B24XX048 | B24XX058 |
| | B24XX009 | B24XX019 | B24XX029 | B24XX039 | B24XX049 | B24XX059 |
| | B24XX010 | B24XX020 | B24XX030 | B24XX040 | B24XX050 | B24XX060 |

- In week (-1), the class teacher of a section shall collect 10-12 topics for practicum from each of the course teachers of that section.
- The class teacher, in consultation with HoD shall allot the practicum topics to the students of that section in the following format.

****

**CIRCULAR**

*Allotment of Practicum topics to students*

*Section : …….*

| S.No. | Roll number | Practicum topic | Practicum under | Course faculty |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | of the student | allotted | the course | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Note:**

1. The students should meet immediately the allotted course faculty for practicum and start working on the practicum with the guidance of course faculty.
2. To complete the Practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and also outside the class work hours during weekdays.
3. The course faculty are advised to guide the allotted students for practicum during the semester course work.

*(Signature of class teacher)*

****

(iv). ***To complete the practicum, the student shall work in laboratories under supervision of allotted course faculty, in the allotted hours in the classwork timetable and outside the class work hours during weekdays.***

(v). There shall be only continuous Internal Evaluation (CIE) for practicum for a maximum of 100 marks.

(vi). The practicum course faculty shall evaluate & submit the final marks of the allotted students in week (N+1) to the respective class teacher.

(vii). The class teacher shall collect the final marks of practicum of the students allotted to each course teacher and submit them to the CoE.

(viii). Course faculty shall follow his/her own rubrics for practicum evaluation. Focus shall be on knowledge, skills & qualities acquired by the student during the practicum course

(ix). A sample rubrics for assessment and evaluation of practicum is as follows:

| | |
|---|---|
| Literature survey & Identification of research gaps | 10 marks |
| Working model / process / software package / system developed | 30 marks |
| Report writing (subjected to max of 30% plagiarism) | 20 marks |
| Oral presentation with PPT and viva-voce | 20 marks |
| Video pitch | 20 marks |
| **Total** | 100 marks |

**Note:** It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation of Practicum.

(o) **Practicum Topic**: Each student shall be allotted a topic for practicum by the course faculty member attached to him/her. Interested students can work on their own title for practicum, but with due approval from course faculty.

(p) **Working Model**: Each student is required to develop a prototype / process /system/simulation model on the given practicum topic and demonstrate/present, during the allotted time, before the course teacher.

(q) **Report:** Each student is required to submit a well-documented report on the allotted practicum topic as per the format specified by the course faculty. The student shall include answers to the following questions in the report and ppt presentation.

- What was the objective of the practicum assigned?
- What are the main responsibilities and tasks for practicum?

- What knowledge and skills from the coursework are applied in the practicum?
- What new knowledge and skills are acquired during the practicum?
- In what ways, can the practicum be helpful for the professional career?
- What gaps are identified in your practicum work?
- What improvements or changes you suggest for addressing the identified gaps for future work?

(r) **Anti-Plagiarism Check:** The practicum report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(s) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the course teacher as per the schedule notified by the department

(t) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her Practicum. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include evidence like videos & pics at the time of implementing the practicum and also key points about his / her business idea / plan (*if any*) and social impact

(u) The student has to register for the Practicum as a supplementary examination in the following cases:

i) he/she is absent for oral presentation and viva-voce
ii) he/she fails to submit the report in prescribed format
iii) he/she fails to fulfill the requirements of Practicum evaluation as per specified guidelines

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: synthesize literature survey, identify research gaps and define objective & scope of practicum problem

**CO2**: apply knowledge to design & conduct experiments, utilize modern tools for solution of practicum problem and develop working model/ process/ system

**CO3**: demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through practicum

**CO4**: create a video pitch on practicum and make an effective oral presentation using PPTs

| **Course Articulation Matrix (CAM):** | | **U24EL308 PRACTICUM -3** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24EL308.1** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **CO2** | **U24EL308.2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **CO3** | **U24EL308.3** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **CO4** | **U24EL308.4** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| **U24EL308** | | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

## SOCIAL EMPOWERMENT ACTIVITY / SELF ACCOMPLISHMENT ACTIVITY (SEA-3 /SAA-3)

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24VA309** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-2-2** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** **holistic development** through activity-based learning to gain real-life experience which effectively help individuals deal appropriately with problems/challenges

**LO2:** **positive mindset** by actively adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity and handling rejection in life

**LO3:** **skills for effective fieldwork practice,** which include ethics, observation, communication, interviewing, problem solving, time management, organisation and documentation

**LO4:** **making a well-documented report and an effective oral presentation** through PPTs portraying knowledge, skills, qualities acquired and social impact of the activity

Activity Based Liberal Learning about Life, Literature and Culture (ABLL@LLC) is introduced for building **generic competencies** in students. ABLL is aimed at all dimensional holistic growth of the learner. The holistic development includes the **physical, emotional, cognitive, spiritual and social aspects**. This is an area which opens the decision-making process, helps the student to develop creativity, an analytical mind, and builds resilience, confidence, hope, well-being and success. This will help student face the world with a greater degree of maturity, stoic and become a wholesome person in the society.

It is more than just learning from books to lead a successful life. These activity-based liberal learning courses, which help students to expand their social roles later in life, are offered under two sequels namely **SEA** (Social Empowerment Activities) and **SAA** (Self Accomplishment Activities)

These SEA/SAA courses also focus on building positive mindset: adopting optimism, acceptance, resilience, gratitude, mindfulness, and integrity in your life will help student develop and maintain a positive mindset.

(f) Each SEA/SAA activity is treated as one credit course

(g) Student must select one activity per semester, through first 04 semesters, from the courses listed under SEA/ SAA, before commencement of the semester.

(h) Students are required to earn minimum 04 credits under SEA/SAA, by completing minimum 02 credits through SEA and minimum 02 credits through SAA

(i) To complete these activities student shall work outside the class work hours, during weekends, holidays, semester breaks, etc.,

(j) If a student is not able to attend/ fulfil performance requirements, he/she shall be dropped from the course and shall have to enrol in the forthcoming semesters.

***Monitoring SEA/SAA:***

(h) **Nodal units:** The Student Activity Centre (SAC) and Centre for Innovation Incubation Research and Entrepreneurship (C-i²RE) shall act as nodal units for activities listed under SEA/SAA.

(i) During the semester period, the student has to **acquire requisite knowledge**, **conduct fieldwork**, acquire skills and propose unique solutions to the real-life problems

(j) **Knowledge Acquisition & Skilling**:

iv. Students have to identify goals, acquire and accumulate knowledge on the chosen SEA/SAA activity

v. For the activities related to social awareness/issues/challenges that affect society, use the knowledge base, apply relevant skills to analyse the issue and propose unique possible solutions to the social issues/challenges. Practice to acquire necessary skills to seek new opportunities in their personal and professional life.

vi. For the activities related to physical fitness, music, dance, fine arts, etc., guided practice sessions under supervision of expert/guru are to be planned and executed to acquire the benchmark skills to be demonstrated.

(k) **Fieldwork:** Fieldwork is an essential component of learning for gaining real-life experiences. In addition to knowledge acquisition & skilling, student has to take up fieldwork on the chosen activity, as part of SEA/SAA course.

xv. This student-driven Fieldwork allow students to interact with the 'real world'. It is an autonomous learning (self-learning) situation that students are more actively involved during the activity and develop a deeper understanding and develop a more positive attitude.

xvi. Fieldwork consists of three phases: preparation, the actual activity and feedback

**xvii. As part of fieldwork, student has to interact with at least two eminent personalities/achievers/renowned persons/inspiring and great personalities related to the activity chosen.**

xviii. Fieldwork will benefit students for any careers where they need to work with communities of people or which involves analysis of complex processes, especially social and cultural.

xix. Certain skills are required for effective fieldwork, which include observation, communication, interviewing, problem solving, documentation, and more

xx. Other skills important for fieldwork practice include the ability to act in a crisis, to plan, set priorities, mobilize resources, and implement the plan effectively. These skills used in an integrated manner help students solve their problems and to develop one's own leadership style based on the need and culture of the place.

xxi. **Eminent personalities/achievers/renowned persons/inspiring and great personalities**

*Eminent personalities/ Achievers / Renowned personalities:*

(a). **In case of socially relevant problems/ activities of SEA/SAA: E**minent personalities/ achievers include district administrative officers, Eminent Social workers / NGOs, other inspiring and great personalities

(b). **In case of Sports / Games and Cultural activities of SEA/SAA:** Eminent coaches/ trainers/gurus, achievers who represented/won state level/national level /international level competitions, other inspiring and great personalities.

xxii. **For appointment to interact eminent personalities**: Student is expected to follow email etiquette rules and other appropriate polite communication etiquettes for getting appointment and time for

interaction

xxiii. On fieldwork, student is expected to demonstrate solid time management, organisational and note taking skills during fieldwork

xxiv. **Ethics of fieldwork**: Fieldwork is an educational process with commitment to positive values. All fieldwork should be planned and conducted in a way that is ethical, responsible and safe, for people, students, visited communities, if any, and all other stakeholders. Student is expected to maintain integrity and honesty. Avoid bias and deception. Protect the rights and well-being of people involved in fieldwork. The privacy, confidentiality and respect for the eminent people interacted should be maintained and their time, inputs & guidance are to be acknowledged

xxv. Student is expected to take care of health and Safety practices for fieldwork and travel

xxvi. Student should remember that contrary to a *field trip or company visit*, **the emphasis in fieldwork is on acquiring skills**, and not on casually presenting theory and assessing.

xxvii. For the fieldwork, student shall go with a scientifically designed questionnaire and record the responses during interaction. These response sheets, along with geo-tagged pic of fieldwork (at the time of interaction & practise sessions, if any) shall be appended as annexures in the report to be submitted for course evaluation.

xxviii. **Feedback:** The learnings the student made out of interaction with eminent achievers shall be presented in the report as one of the chapters.

- During feedback, the central focus is on the elaboration of the students' experience during fieldwork. Therefore, the student should create an end product, such as a demonstration/presentation and report in which they demonstrate a link between their experiences during fieldwork and the underlying theoretical concepts and ideas.

(l) **Demonstration / Presentation and Report**: Student after presentation/demonstration of his/her achievements/work, shall get a certificate from the concerned nodal unit and submit a report, in the prescribed format, to the faculty counsellor for award of grade.

(m) **Flow process for completion of SEA/SAA course**:

xi. ***Faculty counsellor approval***: In week (-1), in consultation with faculty counsellor, every student shall, identifies minimum of 4 activities listed under SEA/SAA activities, lists their priority and fills the same in ONLINE REGISTRATION FORM FOR SEA/SAA (received in their domain mail id) to Dean, Student Affairs. Dean, Student Affairs shall release the section wise allotment of SEA/SAA courses to students along with the details of supervising faculty of nodal centre. The allotment details shall be shared to the SEA/SAA coordinator and the student through domain mail id of the student

xii. ***Identification of goals and preparation of action plan:*** In week (1), the respective faculty coordinator(s) of nodal centres shall address the students allotted to them to educate them on fixing goals, plan of action for completion and evaluation. In consultation with nodal centre, based on the workflow of the allotted activity, every student shall identify the goals (of activity) & eminent personalities (to be visited during the field trip) and prepare action plan (oriented workflow) for attaining the identified goals.

xiii. ***Field work:*** Under the guidance of nodal centre, student shall complete the field work, based on the action plan, with the progress continuously monitored by the faculty counsellor and the nodal centre.

xiv. ***Demonstration/ Presentation:*** After completion of field work, student shall demonstrate/present

his achievements (knowledge/skills gained during the activity) at the nodal centre in the presence of external experts/senior practitioners of the activity. After successful demonstration/presentation, the nodal centre shall provide a certificate of completion indicating that the student has completed the activity in the stipulated time.

xv. ***Report writing:*** After successful demonstration/presentation, student shall write a 2–3-page report and submit the same to the faculty counsellor. The report shall emphasize knowledge, skills and qualities acquired through the SEA/SAA activities. It shall also include the influence of these activities on enhancing confidence, positive change in life, decision making, transforming choices into desired actions/outcomes.

(n) ***Assessment & Evaluation:*** There shall be *only Continuous Internal Evaluation (CIE) for SEA/SAA*. The SEA/SAA activities shall be evaluated at the end of the semester through respective evaluation processes, which shall include field work, presentation/ demonstration, submission of reports on the gathered data/information/ surveys, the details of which have been shown in below table. The department level SEA/SAA coordinator shall collect marks from the nodal centres and faculty counsellors, consolidate them, and submit the final grades to the examination branch, within one week of the last day of instruction. Evaluation of SEA/SAA activities shall be completed as and when students are ready, but not later than week (N+1).

***The CIE for SEA/SAA is as follows:***

| Assessment | Maximum marks | Marks to be awarded by |
|---|---|---|
| Goal setting, Planning & Knowledge Acquisition | 20 | Nodal centre |
| Field work | 40 | Nodal centre |
| Demonstration/Presentation | 20 | Nodal centre |
| Report submission | 20 | Faculty counsellor |
| **Total** | **100** | **-** |

***Note:***

(f) **Presentation/ Demonstration:** It is mandatory for the student to appear for demonstration and (or) oral presentation oral presentation to qualify for course evaluation. In case of presentation, student should prepare PPT with informative slides including the geo tagged photos of his/her field trips/interactions as per the schedule notified by the nodal centre. In case of demonstration, student must take timeslot from the nodal centre and demonstrate the skills learnt/improved during the allotted timeslot.

- The necessary arrangements for demonstration shall be looked after the student in consultation with the coordinator with due permission from Head of the department.

(g) **Report:** Each student is required to submit a well-documented report on the chosen SEA/SAA topic as per the format specified by *department level SEA/SAA coordinator.*

(h) **Anti-Plagiarism Check:** The SEA/SAA report should clear plagiarism check as per the Anti-Plagiarism policy of the institute.

(i) **Requirements for passing the course:** A student is deemed to have passed SEA/SAA if he/she

a. successfully demonstrates/presents the skills attained at the end of course as per the schedule notified by the nodal centre, **and**
b. scores a minimum of 40 marks in the CIE of the course

(j) **Supplementary examination:** If a student fails in SEA/SAA activity of a particular semester, he must

complete the same by enrolling it in the next higher semesters.

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: integrate the five dimensions of physical, emotional, cognitive, spiritual and social aspects in life for holistic development and demonstrate social sensitivity

**CO2**: interact effectively through written, oral and nonverbal communication with external world in a professional, sensitive and culturally relevant manner

**CO3**: analyse the issues related to social empowerment / self-accomplishment, demonstrate problem-solving skills, articulate solutions and demonstrate social sensitivity

**CO4**: demonstrate the generic competencies in making a well-documented report and an effective oral presentation with PPTs portraying knowledge, skills, qualities acquired through fieldwork/practice sessions and social impact of the course learning

**Text / Reference book(s):**

*For knowledge acquisition, students shall refer to textbooks and web resources relevant to the course selected. Plan for fieldwork/practice sessions in coordination with SEA/SAA coordinator*

| **Course Articulation Matrix (CAM):** | | **U24VA309- SEA-3/ SAA-3** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24VA309.1** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO2** | **U24VA309.2** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO3** | **U24VA309.3** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **CO4** | **U24VA309.4** | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 |
| **U24VA309** | | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | 2 | **1** | **1** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

**Course Code**: **U24VA XYY(SE/SA)ZZZ**

***X represents semester; YY represents SEA/SAA course serial number in that semester; SE- represents SEA activity or SA – represents SAA activity; ZZZ represents activity code from SEA/SAA baskets***

| Ex: If A student selects a SEA/SAA course as below: | Ex: If A student selects a SEA/SAA course as below: |
|---|---|
| *Semester: 1*<br>*SEA/SAA course serial number: 09*<br>*SEA/SAA category: SEA*<br>*course number: 302*<br>The **course code** will be U24VA109SE302 | *Semester: 4*<br>*SEA/SAA course serial number: 10*<br>*SEA/SAA category: SAA*<br>*course number: 206*<br>The **course code** will be U24VA410SA206 |

# EXPERT TALK SERIES-3

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24AE310** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O-E):** | **0-0-0-1-1** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE :** | **-** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** 21st century skills needed for industry, current industry trends, challenges and innovations

**LO2:** latest technology in practice and applying knowledge to solve real-world problems

**LO3:** smart work, soft skills, professional etiquette, networking abilities

**LO4:** making a well-documented report portraying the knowledge, skills, qualities acquired and the impact of the learning

**In the 21st century, for successful career, degree alone won't suffice. Competencies are much more important**.

(q) You need to be aware of the real-world problems, industry working style, need to be confident and smart and you also need to know the tricks of the trade.

(r) Learning from industry experts with real-world examples, is important to enhance your educational experience.

(s) Enhanced graduate employability benefits all stakeholders. To effectively enhance employability and the immediacy of adding value to company/project, it is important that you are aware of what you are learning and its use in the workplace. The cognitive abilities viz., remember, understand, recall, and application of knowledge and other skills acquired in higher education can be maximised if you are clear on the purpose of your developed competencies and how to apply them in a range of complex situations.

(t) Graduate employability could be enhanced through fostering lifelong learning, the development of a range of employability-related competencies and increased confidence and capacity in "reflecting on and articulating these capabilities and attributes in a range of recruitment situations".

**But how would you know all this without venturing into the industry?**

(u) The answer is Industry **Expert Talk Series (ETS)**. Through ETS, we invite industry experts in different fields to deliver talks and interact with students.

(v) Through Industry expert talks students get to know so much more that textbooks don't explain.

(w) Students have the opportunity to learn from professionals who have achieved success in their respective fields. These speakers often share their personal experiences, case studies, and anecdotes, providing students with real-world examples and perspectives that go beyond theoretical concepts.

(x) Our competency-focussed curriculum URR24 is designed to contribute greatly to the nurturing and development of each of these facets among students through ETS courses

(y) ETS helps students gain improved industry engagement for an easier transition into the workplace, broader career progression opportunities and personal development.

(z) In URR24 curriculum, Expert talk series (ETS) is offered as a course under **ability enhancement category of courses**.

(aa) Through ETS sessions, students get the chance to interact with industry regularly which helps them focus on the needs and requirements of current industry. This will not only enthuse the students with new ideas but also motivate them to understand what kind of 21st century skills are needed in industry

and how they need to groom themselves.

(bb) Through ETS sessions, another benefit is that students learn the importance of soft skills like communication, presentation, email etiquettes, corporate grooming and dressing styles. Conversing with successful people is the biggest motivation and students gain in more ways than one through ETS sessions.

(cc) ETS enhances your learning in many ways for global opportunities for your career.

(dd) All in all, learning from industry experts**,** is a wonderful opportunity for student to getting acquainted with professional etiquette, acquiring professional knowledge, and getting to know the internal workings of an organization.

(ee) Salient features of ETS are hereunder:

(xii) ETS is offered from I semester to VI semester.

(xiii) ETS, in any given semester, is treated as one credit course

(xiv) Students are required to earn six credits (from I to VI semester)

(xv) **Head, Centre for i²RE** shall be the **institute level ETS coordinator**

(xvi) Under this course, a minimum of 10 expert talks shall be organized in **online/offline mode** by the parent department / Centre for i²RE.

(xvii) Each expert talk shall be for a minimum duration of 45 minutes (*but not exceeding 90 minutes*) followed by **online quiz/test** for 10 marks (10 MCQs/FiBs ; *duration: 10-15 mins*), on the contents covered in the expert talk.

(xviii) **The Head C-i²RE** shall share the marks obtained by the students in each of the quizzes / tests to the respective **department ETS coordinators.**

(xix) Each student shall attend a minimum of 6 expert talks and attempt the corresponding quizzes/ tests conducted at the end of the talks.

(xx) **Report on ETS:** At the end of semester, the student shall submit a well-documented report on the acquired knowledge and skills, in the prescribed format, to the department ETS coordinator.

(xxi) **Evaluation:** There shall be only continuous Internal Evaluation (CIE) for ETS for a maximum of 100 marks

(xxii) The department ETS coordinator shall, in coordination with institute level ETS coordinator, submit the final scores to the CoE in week (N+1).

(ff) The CIE for ETS is as follows:

*Rubrics for evaluation of ETS*

| | |
|---|---|
| Quiz score<br>(*sum of best 6 quiz scores out of 10 quizzes. Each quiz evaluated for 10 marks*) | 60 marks |
| Attendance (*out of 10 quizzes*) | 20 marks |
| Report in prescribed format (*max 30% plagiarism*) | 20 marks |
| **Total** | **100 marks** |

iii. **Attendance**: Maximum of 20 marks shall be awarded based on the attendance maintained by the student over a maximum of 10 lectures.

$$Marks\ for\ attendance = \frac{Number\ of\ expert\ talks\ attended\ fully}{10} * 20$$

**iv. Supplementary Exam:**

(i) Student has to register for ETS supplementary examination if he/she scores less than 40 marks in CIE

(j) The ETS supplementary examination shall be conducted by the parent department, in physical mode, for 100 marks (MCQs/FiBs ; *duration: 2Hrs*) on the content covered in ETS lectures.

(k) Department ETS coordinator shall, in coordination with the institute level ETS coordinator, conduct the supplementary exam, and submit scores to the CoE

(l) Exam material/resources for supplementary: Recorded videos of ETS arranged for that semester, which shall be made available on ETS webpage of institute website

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO5:** identify real-world problems, different career paths, industry requirements, emerging job roles, business practices and exploit new opportunities by staying up-to-date with industry knowledge, trends and technology

**CO6:** identify what 21st century employability-related skills and professional etiquette are must in a range of recruitment situations, what skills are absent in him/her, and demonstrate skill improvement

**CO7:** interact with experts, exhibit confidence, demonstrate improved communication and networking abilities potentially leading to mentorship opportunities, internships, or even future job prospects

**CO8:** demonstrate the generic competencies in making a well-documented report portraying knowledge, skills, qualities acquired through ETS sessions and impact of the expert talks

| **Course Articulation Matrix (CAM):** | | **U24AE310 EXPERT TALK SERIES-3** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | U24AE310.1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO2** | U24AE310.2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO3** | U24AE310.3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **CO4** | U24AE310.4 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 1 |
| **U24AE310** | | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **1** | **2** | **1** | **2** | **1** | **1** |

# Semester -IV Syllabi

## IV SEMESTER

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | PCC | U24CI401 | VLSI Design | 2 | 1 | - | 3 | 3 |
| 2 | PCC | U24CI402 | Digital Signal Processing | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI403 | Electromagnetic Theory and Wave Propagation | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI404 | Computer Architecture and Microprocessors | 2 | 1 | - | 3 | 3 |
| 5 | ESC | U24CI405 | Python Programming | 2 | 1 | - | 3 | 3 |
| 6 | VAC | U24VA406B | Soft and Interpersonal Skills Lab | - | - | 2 | 2 | 1 |
| 7 | SEC | U24SE407 | Programming Skill Development Laboratory – 3 (Java) | - | - | 2 | 2 | 1 |
| 8 | PCC | U24CI408 | VLSI Design Laboratory | - | - | 2 | 2 | 1 |
| 9 | PCC | U24CI409 | Digital Signal Processing Laboratory | - | - | 2 | 2 | 1 |
| 10 | PCC | U24CI410 | Python Programming Laboratory | - | - | 2 | 2 | 1 |
| 11 | VAC* | U24CY411* | Environmental Studies* | 2* | - | - | 2* | - |
| **Total:** | | | | **12** | **5** | **10** | **25/ 27*** | **20** |
| Additional Learning[@]: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 25 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

**For Lateral Entry Students Only*

| @U24VA306 T & P Basket | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| **1.** | U24VA406A | Quantitative Aptitude and Logical Reasoning *(for Stream II)* |
| **2.** | U24VA406B | Soft and Interpersonal Skills Lab *(for Stream I)* |

# VLSI DESIGN

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI401** | **Credits:** | **3** |
| **Hours/Week (L-T-P-E):** | **2-1-0-3** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1**: analyze transfer characteristics of CMOS inverter circuits and determine pull up/pull down ratios

**CO2**: develop stick diagrams & mask layouts using design rules and estimate the sheet resistance, area capacitances of layers & time delays of MOS transistors

**CO3**: determine the scaling factors for various device parameters and apply the structured design approach for example circuits

**CO4**: develop Verilog code for digital circuits using behavioural, dataflow, gate and switch levels of abstraction

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to MOS Technology:** Introduction to VLSI, Basic MOS transistor, Process steps in fabricating MOSFET, Fabrication process of nMOS, CMOS and BiCMOS transistors

**Basic Electrical Properties of MOS Circuits:** Drain to source current and voltage relation, Threshold voltage, Transconductance, Pass transistor, nMOS inverter, Pull up/pull down ratios, Alternate forms of pull up, CMOS inverter, BiCMOS inverter, Latch-up in CMOS circuits

| **UNIT-II** | **9 Hrs** |
|---|---|

**MOS Circuit Design Processes:** MOS layers, Stick diagrams - nMOS design style and CMOS design style, Lambda based design rules and layout diagrams

**Basic Circuit Concepts:** Sheet resistance, Area capacitances of layers, Delay unit, Inverter delays, Rise time and fall time estimation

| **UNIT-III** | **9 Hrs** |
|---|---|

**Scaling of MOS Circuits:** Scaling models and scaling factors, Scaling factors for device parameters and limitations of scaling

**Subsystem Design and Layout:** Architectural issues, Switch logic, Gate logic, Examples of structured design, Clocked sequential circuits and system considerations

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Verilog HDL:** Hierarchical modeling concepts, Basic concepts - Data types, Modules and ports, Gate level modeling, Dataflow modeling, Behavioral modeling, Design examples of combinational and sequential circuits, Switch level modeling, Tasks and functions

**Textbook(s):**


1. Douglas A Pucknell and Kamran Eshraghian, *Basic VLSI Design*, 3rd ed., New Delhi: PHI, 2008. *(Chapters 1 to 6)*
2. Samir Palnitkar, Peter Flake, *Verilog HDL – Guide to Digital Design and Synthesis*, 3rd ed., New Delhi: Pearson Education, 2003. *(PART-I: Chapters 2 to 8)*


**Reference Book(s):**

1. Neil H. E. Weste, David Harris and Ayan Banerjee, *CMOS VLSI Design – A Circuits and Systems Perspective*, 3rd ed., New Delhi: Pearson Education, 2005.
2. John P Uyemura, *Chip Design for Submicron VLSI: CMOS Layout and Simulation*, 2nd ed., Thomson/Nelson, 2010.

**Web and Video link(s):**

https://archive.nptel.ac.in/courses/108/107/108107129/ ; *NPTEL Video Lecture on CMOS Digital VLSI Design by Prof. Sudeb Dasgupta, Professor of ECE, IIT Roorkee.*

**https://archive.nptel.ac.in/courses/106/105/106105165/** ; *NPTEL Video Lecture on Hardware modeling using verilog by Prof. Indranil Sengupta, Professor of CSE, IIT Kharagpur.*

**Laboratory Manual (for laboratory component):**

1. *VLSI Design Laboratory Manual and Record Book*, Department of ECIE, KITSW.

| **Course Articulation Matrix (CAM):** | | **U24CI401: VLSI DESIGN** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI401.1** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 1 | 2 | 2 |
| **CO2** | **U24CI401.2** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 1 | 2 | 2 |
| **CO3** | **U24CI401.3** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 1 | 2 | 2 |
| **CO4** | **U24CI401.4** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | 1 | 1 | 2 | 2 |
| **U24CI401** | | **2** | **2** | **2** | **2** | **-** | **-** | **1** | **-** | **1** | **1** | **1** | **2** | **2** |

## DIGITAL SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch: ECIE** | |
| **Course Code:** | **U24CI402** | **Credits:** | **3** |
| **Hours/Week (L-T-P-E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **60 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1**: analyze LTI systems using z-transform and realize the DT systems

**CO2:** compute 2, 4 & 8-point DFT using radix2 DIT & DIF algorithms

**CO3**: design a linear-phase FIR and IIR digital filters for the given specifications

**CO4**: analyze the performance of LMS & RLS algorithms and utilize adaptive filters for noise cancellation applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Z-Transform:** Representing DT signals by complex exponentials, Definition of *z*-transform, Region of convergence (ROC), Properties of *z*-transform, Inverse *z*-transform by partial fractions and long division methods, Analysis and characterization of LTI system using *z*-transform

**Block Diagram Representations:** Structures for IIR systems - Direct, cascade and parallel form realizations of IIR systems

| **UNIT-II** | **9 Hrs** |
|---|---|

**Discrete Fourier Transform (DFT):** Fourier Transform of DT aperiodic signals, Frequency domain sampling and reconstruction of discrete-time signals, DFT, properties of DFT, Circular convolution, Inverse DFT (IDFT), Frequency analysis of signals using DFT Relation between DFT, DTFT and Z-transform

**Fast Fourier Transform (FFT):** Computational complexity of DFT, Introduction to FFT, Radix-2 FFT algorithms, Decimation-in-time FFT algorithm, Decimation-in-frequency FFT algorithm, Inverse DFT using FFT algorithms

| **UNIT-III** | **9 Hrs** |
|---|---|

**Finite Impulse Response (FIR) filters:** Design of linear phase FIR filters - rectangular window, triangular window, hamming window & Hanning window

**Infinite Impulse Response (IIR) Filters:** Design of IIR digital filters from analog filter specifications, Mapping techniques - Impulse invariance and bilinear transformation; IIR digital filter design using Butterworth and Chebyshev approximations, Frequency transformations

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Correlation:** Correlation of discrete time signals, Auto correlation, Properties of auto correlation function, Cross correlation, Matrix form representation, Example problems for computation of correlation functions

**Adaptive Filters:** Concepts of adaptive filtering, configurations, Basic wiener filter theory, Cost function, Error performance surface, Basic LMS algorithm & its implementation, Practical limitations of basic LMS algorithm, RLS algorithm, Limitations of RLS algorithm

**Applications of Adaptive filters:** Fetal monitoring - Cancelling of maternal ECG during labor; Adaptive telephone echo cancellation.

**Textbook(s):**

1. John G.Proakis & D.G.Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4th ed. New Delhi: Pearson education, 2007. (Chapters 3, 7, 8,9,10)
2. Ifeachor, *Digital Signal Processing-A practical Approach,* 4th ed. New Delhi: Pearson Education, 2013. (Chapter 09)

**Reference Book(s):**

1. A.V. Oppenheim & R. W. Schafer, *Discrete-Time Signal Processing*, 2nd ed., New Delhi: PHI, 1999.
2. Sanjit K. Mitra, *Digital Signal Processing – A Computer Based Approach*, 2nd ed., New Delhi: TMH, 2002.
3. Johnny R. Johnson, *Introduction to Digital Signal Processing*, 1st ed., New Delhi: PHI, 2001.
4. Adreas Antanio, *Digital filter Analysis and Design*, 4th ed., New Delhi: *TMH,* 1988.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc24_ee16/preview; *Digital Signal Processing and its Applications by Prof. V. M. Gadre, Professor of EEE, IIT Bombay*

| **Course Articulation Matrix (CAM):** | | **U24CI402: DIGITAL SIGNAL PROCESSING** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI402.1** | 2 | 2 | 3 | 2 | 3 | 1 | - | 2 | 2 | 1 | 2 | 2 | 2 |
| **CO2** | **U24CI402.2** | 2 | 2 | 3 | 2 | 3 | 1 | - | 2 | 2 | 1 | 2 | 2 | 2 |
| **CO3** | **U24CI402.3** | 3 | 2 | 3 | 2 | 3 | 1 | - | 2 | 2 | 1 | 2 | 2 | 2 |
| **CO4** | **U24CI402.4** | 3 | 2 | 3 | 2 | 3 | 1 | - | 2 | 2 | 1 | 2 | 2 | 2 |
| **U24CI402** | | **2.5** | **2** | **3** | **2** | **3** | **1** | **-** | **2** | **2** | **1** | **2** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# ELECTROMAGNETIC THEORY AND WAVE PROPAGATION

| | | | |
|---|---|---|---|
| **Class:** B. Tech. IV -Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI403** | **Credits:** | **3** |
| **Hours/Week (L-T-P-E):** | **2-1-0-3** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1**: determine the electric field at any given point due to charge distribution

**CO2**: apply Biot-Savart's law and Ampere's law for determining magnetic field intensity

**CO3**: analyze the wave propagation in different medium

**CO4**: determine the field components in rectangular waveguides

| **UNIT-I** | **9 Hrs** |
|---|---|

**Review of Vector analysis:** Vector algebra, Del operator, Gradient, Divergence, Curl, Coordinate Systems- Cartesian**,** Cylindrical and Spherical, Stoke's theorem and Divergence theorem.

**Electrostatics:** Coulomb's law and field intensity, Electric fields due to continuous charge distributions, Electric flux density, Gauss's law, Application of Gauss's law, Electric potential, Relation between E and V, Energy density in electrostatic fields, Poisson's and Laplace's equations, Capacitance – Parallel-plate, Coaxial, and Spherical Capacitor, Boundary conditions

| **UNIT-II** | **9 Hrs** |
|---|---|

**Magnetostatics:** Biot-Savart's law, Ampere's circuit law, Magnetic flux density, Magnetic scalar and vector potentials

**Magnetic fields in materials:** Forces due to magnetic fields, Magnetic torque and moment, Magnetic dipole, Magnetic boundary conditions

**Time-varying fields:** Faraday's law, Displacement current, Maxwell's equations in point & integral forms, Time varying potentials

| **UNIT-III** | **9 Hrs** |
|---|---|

**Electromagnetic waves:** Wave propagation in free space, dielectric, and good conductor, Skin effect, Wave polarization

**Power flow:** Poynting's theorem, Time average pointing vector & power flow in an electromagnetic wave

**Reflection & Transmission of plane waves:** Reflection of a plane wave at normal incidence & oblique incidence

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Waveguides:** Rectangular waveguides – Field components in TE & TM mode propagation, Impossibility of TEM mode in rectangular waveguides, Characteristics of rectangular waveguide

**Antenna Fundamentals:** Types of antennas – Hertzian dipole, Half wave dipole antenna, Small loop antenna, Antenna characteristics

**Textbook(s):**

1. Mathew N.O. Sadiku, *Principles / Elements of Electromagnetics*, 4th ed., London: Oxford University Press, 2014.

**Reference Book(s):**

1. W. H. Hayt, J. A. Buck, *Engineering Electromagnetics*, 7th ed., The McGraw-Hill

Companies, 2006.
2. Edward C. Jordan, Keith G. Balmain, *Electromagnetic Waves and Radiating Systems*, 2nd ed., New Delhi: Prentice Hall of India, 2001.
3. Nathan Ida, *Engineering Electromagnetics*, 3rd ed., USA: Springer, 2015.

**Web and Video link(s):**

1. https://youtu.be/G5P6dInMTFg?si=XSb5gcfFt1hFXMrx; *NPTEL Video Lecture on Electromagnetic Theory, Prof. Pradeep Kumar, Professor of Electrical Engineering, IIT Kanpur.*
2. https://youtu.be/pGdr9WLto4A?si=csgylBeDiTJpG6_z; *NPTEL Video Lecture on Electromagnetic Theory, by Prof. Harishankar Ramachandran, Professor of Electrical Engineering, IIT Madras.*

| **Course Articulation Matrix (CAM):** | | **U24CI403 ELECTROMAGNETIC THEORY AND WAVE PROPAGATION** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI403.1** | 3 | 2 | 1 | 1 | - | - | 1 | - | 1 | 1 | 1 | 1 | 2 |
| **CO2** | **U24CI403.2** | 3 | 2 | 1 | 1 | - | - | 1 | - | 1 | 1 | 1 | 1 | 2 |
| **CO3** | **U24CI403.3** | 3 | 2 | 1 | 1 | - | - | 1 | - | 1 | 1 | 1 | 1 | 2 |
| **CO4** | **U24CI403.4** | 3 | 2 | 1 | 1 | - | - | 1 | - | 1 | 1 | 1 | 1 | 2 |
| **U24CI403** | | **3** | 2 | **1** | **1** | **-** | **-** | **1** | **-** | **1** | **1** | **1** | **1** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# COMPUTER ARCHITECTURE AND MICROPROCESSORS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24CI404** | **Credits:** | **3** |
| **Hours/Week (L-T-P-E):** | **2-1-0-3** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40 %** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: design basic elements of a microcomputer's CPU such as common buses, registers, arithmetic logic unit (ALU) & control unit

**CO2**: classify memory and IO transfer methods in microcomputers

**CO3**: examine architectural and programming features of 8086 microprocessor

**CO4**: develop assembly language programs (ALPs) to solve data processing problems

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** Organization and Architecture, History of computers, Block diagram of a digital computer, Register transfer language, Bus and memory transfers

**Basic Computer Design:** Instruction codes, Computer registers, Common bus system, Computer instructions

**Programming Computer**: Machine language, Assembly language, Programming arithmetic and logical operations

**Central Processing Unit**: General register organization, Stack organization, Instruction formats, Addressing modes, Data transfer and manipulation, Program control

**Microprogrammed Control:** Control memory, Address sequencing

| **UNIT-II** | **9 Hrs** |
|---|---|

**Computer Arithmetic**: Addition and subtraction, Multiplication and division algorithms, Floating point representation

**Input-Output Organization**: Peripheral devices, IO interface, Asynchronous data transfer, Modes of IO transfer, Priority interrupt, DMA memory access

**Memory Organization**: Memory hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory

| **UNIT-III** | **9 Hrs** |
|---|---|

**8086 Family Architecture:** Organization of 8086 CPU, Concept of memory segmentation, Segment registers, Physical and logical addressing, Addressing modes, Instruction set

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Assembly Language Programming:** Assembler directives, Simple programming of 8086, Arithmetic, Logical and Data processing programs; Implementation of control loops, Strings

**Textbook(s):**

1. M. Morris Mano, Gibson, *Computer System Architecture,* 3rd ed., New Delhi: Pearson Education Inc., 1993. (Chapters 3 to 12)
2. Yuchang Liu and Glen A. Gibson, *Microcomputer Systems - The 8086/8088 Family Architecture, Programming and Design,* 2nd ed., New Delhi: PHI, 1995. (Chapters 2 to 5)

**Reference Book(s):**

1. W. Stallings, *Computer Architecture and Organization – Designing for Performance,* 7th ed.,

New Delhi: Pearson Education Inc., 2007

2. B. Ram, Sanjay Kumar, *EComputer fundamentals: Architecture and Organization,* 5th ed., New Delhi: New Age International Publishers, 2018.
3. D.V.Hall, *Microprocessors and Interfacing: Programming & Hardware*, 2nd ed., New Delhi: Tata McGraw Hill, 1992.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc23_cs67/preview *NPTEL Course on Computer Architecture* by *Prof. Smruti Ranjan Sarangi, IIT Delhi.*
2. https://archive.nptel.ac.in/courses/106/105/106105163/ *NPTEL Video Lecture on Computer Architecture and Organization by Prof. Indranilsen Gupta and Prof. Kamalika Datta, IIT Kharagpur.*
3. https://onlinecourses.nptel.ac.in/noc20_ee11/preview *NPTEL Course on Microprocessors and Interfacing by Prof. Shaik Rafi Ahamed, IIT Guwahati.*

| **Course Articulation Matrix (CAM):** | | **U24CI404 COMPUTER ARCHITECTURE & MICROPROCESSORS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI404.1** | 2 | 2 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO2** | **U24CI404.2** | 2 | 2 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO3** | **U24CI404.3** | 2 | 2 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | 2 | 2 |
| **CO4** | **U24CI404.4** | 2 | 2 | 1 | 1 | - | - | 1 | - | 1 | - | 1 | 2 | 2 |
| **U24CI404** | | **2** | **2** | **1** | **1** | **-** | **-** | **1** | **-** | **1** | **-** | **1** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PYTHON PROGRAMMING

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch:** Common to All | |
| **Course Code:** | **U24CI405** | **Credits:** | **4** |
| **Hours/Week (L-T-P-E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1:** develop python programs using control statements, operators and functions

**CO2:** apply collections, namespaces, packages, strings and regular expressions in application development

**CO3:** apply object-oriented programming principles in real-time problem solving

**CO4:** develop visualization graphs with Matplotlib and apply Numpy and Pandas libraries for data analysis

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** Features of Python, The future of Python, Writing and executing Python programs

**Python Preliminaries:** Literal constants, Variables and identifiers, Data types, Input operation, Comments, Reserved words, Indentation, Operators, Expressions in Python, Type conversion

**Decision Control Statements:** Selection/Conditional branching statements, Loop structures/ iterative statements, Nested loop, the continue statement, the pass statement

**Functions:** Function definition, Function call, Variable scope and lifetime, the return statement, Advances in defining in functions, Recursive functions, Lambda functions, Iterators, Decorators, Generators

| **UNIT-II** | **9 Hrs** |
|---|---|

**Modules and Name Spaces:** The from…import statement, Naming module, the dir() function, Packages in Python, Standard library modules, globals(), locals(), and reload(), Function redefinition

**Python Strings:** String operations, String formatting operator, Built-in string methods and functions, slice operation, ord() and Chr() Functions, in and not in operators, Comparing strings, Regular expressions and Meta characters

**Data Structures:** Lists, Tuple, Sets, Dictionaries, Comprehensions, High order functions

| **UNIT-III** | **9 Hrs** |
|---|---|

**Python Object Oriented Programming:** Classes and objects, Class method and self-argument, The __init__() method, Class variables and object variables, The __del__() method, Public and private data members, Private methods, Class methods, Static methods, Inheritance, Meat classes, Polymorphism, Operator overloading, Magic Methods

**Error and Exception handling:** Introduction to errors and exceptions, Handling exceptions, Multiple except blocks, Raising exception, Instantiating exceptions, Built-in and User-defined Exceptions, The finally Block, Re-raising exceptions, Assertions, *Multi threading*

**File Handling:** Opening and closing files, Reading and writing files, File positions, Renaming and deleting files, Directory methods

**Database Connectivity:** SQLite, creating a database table, Insert and retrieve data from database

| **UNIT-IV** | **9 Hrs** |
|---|---|

**NumPy:** The basics of NumPy arrays, Array indexing, Array slicing, Reshaping of array,

Concatenation and splitting arrays, Aggregations, Universal Functions, Broad casting of Arrays

**Data Manipulation with Pandas:** Installing and using Pandas, Introducing Pandas objects, data indexing and selection, Handling missing data, Combining datasets, Merge and join, Aggregation and grouping, Vectorized String Operations, Working with Time Series

**Visualization with Matplotlib**: Importing Matplotlib, Saving figures to files, Simple line plots, Simple scatter plots, Histograms, Binnings, and density, Three-Dimensional Plotting in Matplotlib, Geographic Data with Basemap

**Textbook(s):**

1. Reema Thareja, *Python Programming using problem solving approach*, 1st ed. New Delhi: Oxford University Press, 2017 (Chapter 1 to 7)
2. Jake VanderPlas, *Python Data Science Handbook- Essential Tools for Working with Data*, 1st ed. California: O'Reilly Media, 2016 (*Chapter 2 to 4*)

**Reference Book(s):**

1. Dr. Charles R. Severance, *Python for Everybody-Exploring Data Using Python*, 1st ed. New Delhi: Shroff Publishers, 2016
2. David Beazley, *Python Cookbook*, 3rd ed. California: O'Reilly Media, Inc., 2013
3. Caleb Hattingh, *20 Python Libraries You Aren't Using*, 2nd ed. California: O'Reilly Media, 2016
4. Magnus Lie Hetland, *Beginning Python: from Novice to Professional*, 1st ed. New York: Apress, 2005

**Web and Video link(s):**

https://onlinecourses.nptel.ac.in/noc23_cs99/ *NPTEL Video Lecture on Python For Data Science by By Prof. Ragunathan Rengasamy, IIT Madras.*

https://onlinecourses.nptel.ac.in/noc25_cs17 *NPTEL Video Lecture on Data Analytics with Python By Prof. A Ramesh, IIT Roorkee.*

https://onlinecourses.nptel.ac.in/noc25_cs69/ *NPTEL Video Lecture on The Joy of Computing using Python By Prof. Sudarshan Iyengar , IIT Ropar*

**Course Articulation Matrix (CAM): U24CI405: PYTHON PROGRAMMING**

| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | U24CI405.1 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 | 2 | 2 |
| CO2 | U24CI405.2 | 2 | 2 | 2 | 2 | 2 | 1 | - | - | - | 1 | 1 | 2 | 2 |
| CO3 | U24CI405.3 | 2 | 2 | 2 | 2 | 3 | 1 | - | - | - | 1 | 1 | 2 | 2 |
| CO4 | U24CI405.4 | 2 | 2 | 2 | 2 | 3 | 1 | - | - | - | 1 | 1 | 2 | 2 |
| U24CI405 | | **2** | 2 | **2** | 2 | **2** | 1 | - | - | - | 1 | 1 | 2 | 2 |

# SOFT AND INTERPERSONAL SKILLS LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III -Semester & IV-Semester | | **Branch:** Common to all Branches | |
| **Course Code:** | **U24VA406B** | **Credits:** | **1** |
| **Hours/Week (L-T-P-O):** | **0-0-2-2** | **CIE:** | **100 %** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **-** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to…*

**CO1**: deliver concise & effective self-introduction and demonstrate confidence, spontaneous speaking skills within a limited time

**CO2**: conduct a personal SWOT analysis to identify areas for self-improvement and career development

**CO3**: demonstrate clear & respectful communication, leadership, positive attitude and improve interpersonal relationship by actively participating in group discussions, collaborative tasks & mock interviews

**CO4**: create a professional resume, develop a LinkedIn profile and demonstrate effective video communication by making effective videos on self-introduction, personal SWOT analysis & spontaneous speaking activity along with email & workplace etiquette

**LIST OF ACTIVITIES**

**Activity 1: Ice-breaking, Self-Awareness and Just a Minute (JAM)**

**Activity 2: Self-Introduction & Personal SWOT Analysis**

**Activity 3: Reading Comprehension & Critical Thinking**

**Activity 4: Active Listening & Non-Verbal Observation (Video + Peer Practice)**

**Activity 5: Group Discussion - 1**

**Activity 6: Resume Building & LinkedIn Profile Review**

**Activity 7: Group Discussion - 2**

**Activity 8: Presentation Skills with PPT / Storytelling**

**Activity 9: Group Discussion - 3**

**Activity 10: Mock Interviews: Technical & HR**

**Activity 11: Email Etiquette & Professional Communication**

**Activity 12: Workplace Etiquette & Conflict Resolution**

**Textbook(s):**

1. Krishna Mohan & Meera Benerji, *Developing Communications Skills*, 2nd ed., New Delhi: Mcmillan Publications, 2005

| Course Articulation Matrix (CAM): | | U24VS406B SOFT AND INTERPERSONAL SKILLS LABORATORY | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24VA406B.1 | - | - | - | - | - | - | - | 2 | 3 | - | 1 | - | - |
| CO2 | U24VA406B.2 | - | - | - | - | - | - | 2 | 3 | 3 | - | 1 | - | - |
| CO3 | U24VA406B.3 | - | - | - | - | - | - | - | 2 | 3 | - | 1 | - | - |
| CO4 | U24VA406B.4 | - | - | - | - | - | - | 1 | 2 | 3 | - | 1 | - | - |
| U24VA406B | | - | - | - | - | - | - | 1.5 | 2.25 | 3 | - | 1 | - | - |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# VLSI DESIGN LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI408** | **Credits:** | **1** |
| **Hours/Week (L-T-P-E):** | **0-0-2-2** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **40 %** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on psychomotor skills acquired from laboratory component)*

**CO1** : design combinational and sequential circuits using logic gates and flip flops
**CO2** : develop the layouts for digital CMOS VLSI circuits
**CO3** : test the functionality of digital circuits using Verilog HDL
**CO4** : utilize the Electronic Computer Aided Design (ECAD) tools for simulation and verification of VLSI circuits

**List of Experiments**

1. Realization of logic functions using universal gates
2. Implementation of Full adder and Full Subtractor using multiplexer/demultiplexer
3. Realization of Boolean functions using Decoders
4. Implementation of 4-bit Asynchronous counter using flipflops
5. Design, layout and simulation of CMOS NOT circuit
6. Design, layout and simulation of CMOS NAND circuit
7. Design, layout and simulation of CMOS NOR circuit
8. Design, layout and simulation of CMOS circuit for a given Boolean function
9. Design and simulation of 4-bit Adder using Verilog HDL
10. Design and simulation of flip-flops (SR, D, JK & T) using Verilog HDL
11. Design and simulation of 4-bit shift register using Verilog HDL
12. Design and simulation of 4-bit counter using Verilog HDL

**Textbook(s):**

3. Douglas A Pucknell and Kamran Eshraghian, *Basic VLSI Design*, 3rd ed., New Delhi: PHI, 2008. *(Chapters 1 to 6)*

4. Samir Palnitkar, Peter Flake, *Verilog HDL – Guide to Digital Design and Synthesis*, 3rd ed., New Delhi: Pearson Education, 2003. *(PART-I: Chapters 2 to 8)*

**Reference Book(s):**

3. Neil H. E. Weste, David Harris and Ayan Banerjee, *CMOS VLSI Design – A Circuits and Systems Perspective*, 3rd ed., New Delhi: Pearson Education, 2005.

4. John P Uyemura, *Chip Design for Submicron VLSI: CMOS Layout and Simulation*, 2nd ed., Thomson/Nelson, 2010.

**Web and Video link(s):**

1. https://archive.nptel.ac.in/courses/108/107/108107129/ ; *NPTEL Video Lecture on*

*CMOS Digital VLSI Design by Prof. Sudeb Dasgupta, Professor of ECE, IIT Roorkee.*

2. **https://archive.nptel.ac.in/courses/106/105/106105165/** ; *NPTEL Video Lecture on Hardware modeling using verilog by Prof. Indranil Sengupta, Professor of CSE, IIT Kharagpur.*

**Laboratory Manual (for laboratory component):**

1. *VLSI Design Laboratory Manual*, Department of ECIE, KITSW.

| **Course Articulation Matrix (CAM):** | | **U24CI408: VLSI DESIGN LABORATORY** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI408.1** | 2 | 2 | 2 | 2 | 2 | - | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| **CO2** | **U24CI408.2** | 2 | 2 | 2 | 2 | 2 | - | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| **CO3** | **U24CI408.3** | 2 | 2 | 2 | 2 | 2 | - | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| **CO4** | **U24CI408.4** | 2 | 2 | 2 | 2 | 2 | - | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| **U24CI408** | | **2** | **2** | **2** | **2** | **2** | **-** | **1** | **2** | **2** | **2** | **1** | **2** | **2** |

## DIGITAL SIGNAL PROCESSING LAB

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch: ECIE** | |
| **Course Code:** | **U24CI409** | **Credits:** | **1** |
| **Hours/Week (L-T-P-E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

*(based on psychomotor skills acquired from laboratory component)*

**CO1** : simulate DT signals and perform operations on the sequences

**CO2** : analyze the spectrum of a given signal using FFT algorithms

**CO3** : design IIR and FIR digital filters

**CO4** : design a digital filter for biomedical and communication applications

**List of Experiments**

Develop a MATLAB Program to

1. Generate elementary DT Signals
2. Perform scaling, shifting and delay operations on the sequences
3. Perform the Correlation and Convolution of two sequences
4. Compute DFT and 4-pt FFT
5. Observe the spectrum of a given signal
6. Characterize LTI system using Z-transform (impulse response, poles and zeros, frequency response and linear phase characteristics )
7. Design Butterworth IIR Filters to meet the given specifications
8. Design Chebyshev IIR filters to meet the given specifications.
9. Design FIR Filters using windows
10. Remove Power line interference (PLI) from ECG signal using Notch filters
11. Perform modulation and demodulation of Amplitude Modulation (AM)
12. Perform up/down sampling

**Textbook(s):**


1. John G.Proakis & D.G.Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4th ed. New Delhi: Pearson education, 2007. (Chapters 3, 7, 8,9,10)
2. Ifeachor, *Digital Signal Processing-A practical Approach,* 4th ed. New Delhi: Pearson Education, 2013. (Chapter 09)


**Reference Book(s):**


1. A.V. Oppenheim & R. W. Schafer, *Discrete-Time Signal Processing*, 2nd ed., New Delhi: PHI, 1999.
2. Sanjit K. Mitra, *Digital Signal Processing – A Computer Based Approach*, 2nd ed., New Delhi: TMH, 2002.
3. Johnny R. Johnson, *Introduction to Digital Signal Processing*, 1st ed., New Delhi: PHI, 2001.
4. Adreas Antanio, *Digital filter Analysis and Design*, 4th ed., New Delhi: *TMH,* 1988.


**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc24_ee16/preview; *Digital Signal Processing and its Applications by Prof. V. M. Gadre, Professor of EEE, IIT Bombay*

**Laboratory Manual :**

*1. Digital Signal processing Laboratory Manual,* Department of ECIE, KITSW.

| **Course Articulation Matrix (CAM):** | | **U24CI409: DIGITAL SIGNAL PROCESSING LABORATORY** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI409.1** | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 |
| **CO2** | **U24CI409.2** | 2 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 |
| **CO3** | **U24CI409.3** | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 |
| **CO4** | **U24CI409.4** | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 2 |
| **U24CI409** | | **2.5** | **2** | **3** | **2** | **3** | **1** | **1** | **1** | **2** | **1** | **2** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PYTHON PROGRAMMING LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV -Semester | | **Branch:** Common to All | |
| **Course Code:** | **U24CI410** | **Credits:** | 1 |
| **Hours/Week (L-T-P-E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

**CO1:** implement and test python programs using operators, control statements &functions
**CO2:** Implement and test python packages using string handling methods, regular expressions, and collections
**CO3:** implement and test object oriented paradigms and database operations in Python programming
**CO4:** build visualization graphs with Matplotlib and adapt packages like Numpy, Pandas for data analysis

## List of Experiments

**Experiment-I:**

1. Installation of Python and verifying PATH environment variable
2. Running instructions in Interactive interpreter and a python script
    a. Executing instructions in Python Interactive Interpreter
    b. Running python scripts in Command Prompt
    c. Running python scripts in IDLE
3. Develop a Python program to demonstrate importance of indentations. Purposefully raise indentation error and correct it
4. Develop a Python program to take input text as command line argument and display it on screen

**Experiment-II**

1. Develop a Python program that takes 2 numbers as command line arguments and print its sum
2. Develop a Python program to check whether the given number is even or odd
3. Develop a Python program to calculate GCD of 2 numbers
4. Develop a Python program to find Exponentiation (Power) of a number
5. Develop a Python program to find given year is leap year or not
6. Develop a Python program to develop a simple calculator

**Experiment-III**

1. Develop a Python program to find the Factorial of a given number
2. Develop a Python program to find the Armstrong for a given number

3. Develop a Python program to take a number as input, and print countdown from that number to zero (use while loop)
4. Develop a Python program to demonstrate Iterators
5. Develop a Python program to demonstrate Decorators
6. Develop a Python program to demonstrate Generators

**Experiment-IV**

1. Develop a Python program to implement a module using import statement (Use python source file as a Module and implement import statement another python source files)
2. Develop a Python program to implement from, import statement
3. Develop a Python program to implement dir() function
4. Develop a Python program to demonstrate packages in python

**Experiment-V**

1. Develop a Python python program on strings for the following
2. To display substring in a string
3. To update an existing string
4. To implement string concatenation
5. To demonstrate string formatting operator
6. Develop a Python program to demonstrate use of slicing in strings
7. Develop a Python program to compare two strings
8. Reverse string and call this function for performing the operation)
9. Develop a Python program to demonstrate regular expression functions
10. Develop a Python program to demonstrate regular expressions using Meta characters

**Experiment-VI**

1. Develop a Python program to demonstrate list and related functions
2. Develop a Python program to demonstrate tuple and related functions
3. Develop a Python program to demonstrate set and related functions
4. Develop a Python program to demonstrate dictionaries
5. Develop a Python program to demonstrate comprehensions
6. Develop a Python program to demonstrate high order functions

**Experiment-VII**

1. Develop a python program to demonstrate classes and objects

2. Develop a python program to demonstrate class method
3. Develop a python program to demonstrate static method
4. Develop a python program to demonstrate inheritance
5. Develop a python program to demonstrate polymorphism
6. Develop a python program to demonstrate magic methods.

**Experiment-VIII**

1. Develop a python program to demonstrate multiple exception handling
2. Develop a python program to demonstrate multiple exception rising
3. Develop a python program to demonstrate multiple finally block
4. Develop a python program to demonstrate Assertions
5. Develop a python program on file operations for the following
6. To open and read data from a file
7. To write data into a file
8. To compute number of characters, words, lines in a file

**Experiment-IX**

1. Develop a python programs to implement database connectivity
2. Install and verify SQLite Connector for Python
3. To connect check SQLite Database connectivity
4. To retrieve and display data from a table
5. To insert data into a table
6. To delete rows in a table

**Experiment-X**

1. Develop a Python program to demonstrate NumPy array
2. Develop a Python program to demonstrate Slice operation
3. Develop a Python program to demonstrate Reshaping of an array
4. Develop a Python program to demonstrate Ufunctions
5. Develop a Python program to demonstrate Broadcasting of numpy arrays
6. Develop a Python program to demonstrate Aggregate operations

**Experiment-XI**

1. Develop a Python pandas program to create a series from a ndarray
2. Develop a Python pandas program to create a series from input files
3. Develop a Python pandas program to demonstrate indexing and slicing data frames
4. Develop a Python pandas program to demonstrate handling missing values
5. Develop a Python pandas program to demonstrate vectorized string operations,
6. Develop a Python pandas program to demonstrate handling time series data

**Experiment-XII**

1. Develop a Python program to draw a simple line plot
2. Develop a Python program to draw a scatter plots
3. Develop a Python program to draw a histogram plot
4. Develop a Python program to draw a binning and density
5. Develop a Python program to demonstrate a three dimensional plotting
6. Develop a Python program to demonstrate a geographic basemap

**Textbook(s):**

1. Reema Thareja, *Python Programming using problem solving approach*, 1st ed. New Delhi: Oxford University Press, 2017 (Chapter 1 to 7)
2. Jake VanderPlas, *Python Data Science Handbook- Essential Tools for Working with Data*, 1st ed. California: O'Reilly Media, 2016 (*Chapter 2 to 4*)

**Reference Book(s):**

1. Dr. Charles R. Severance, *Python for Everybody-Exploring Data Using Python*, 1st ed. New Delhi: Shroff Publishers, 2016
2. David Beazley, *Python Cookbook*, 3rd ed. California: O'Reilly Media, Inc., 2013
3. Caleb Hattingh, *20 Python Libraries You Aren't Using*, 2nd ed. California: O'Reilly Media, 2016
4. Magnus Lie Hetland, *Beginning Python: from Novice to Professional*, 1st ed. New York: Apress, 2005

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc23_cs99/ *NPTEL Video Lecture on Python For Data Science by By Prof. Ragunathan Rengasamy, IIT Madras.*
2. https://onlinecourses.nptel.ac.in/noc25_cs17 *NPTEL Video Lecture on Data Analytics with PythonBy Prof. A Ramesh, IIT Roorkee.*
3. https://onlinecourses.nptel.ac.in/noc25_cs69/ *NPTEL Video Lecture on The Joy of Computing using Python By Prof. Sudarshan Iyengar , IIT Ropar*

**Laboratory Manual (for laboratory component):**

1. *Python Programming Laboratory Manual and Record Book,* Department of ECIE, KITSW.

| **Course Articulation Matrix (CAM):** | | **U24CI410: PYTHON PROGRAMMING LABORATORY** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI410.1** | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **CO2** | **U24CI410.2** | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **CO3** | **U24CI410.2** | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **CO4** | **U24CI410.2** | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| **U24CI410** | | **2** | 2 | **2** | 2 | **3** | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |

# II Year
# Exit Courses
# Syllabi

**Bridge Courses for exit:**

**Successful completion of two subjects (6-Credits) during 2-months internship at the institute**

**OR**

**Successful completion of two suitable skill based courses (external) to qualify for Certification**

## B. After Second Year: (UG Diploma in ECIE)

**(i) The candidate should pass any two of the following additional courses (Diploma Level) during the 2-Months internship at institute**

| Exit Options to Qualify for UG Diploma in ECIE: Any Two (02) Courses during the 2 - Months internship | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S. No. | Category | Course Code | Course Title | L | T | P | O | E | C |
| 1 | PCC | U24CI412X | Introduction to Microcontrollers and Embedded Systems | 2 | - | 2 | - | 4 | 3 |
| 2 | PCC | U24CI413X | Fundamentals of Internet of Things | 2 | - | 2 | - | 4 | 3 |
| 3 | PCC | U24CI414X | Printed Circuit Board Design | 2 | - | 2 | - | 4 | 3 |
| 4 | PCC | U24CI415X | Any other course approved by BoS Chair and Dean AA | 2 | - | 2 | - | 4 | 3 |

**(OR)**

**(ii) Any two suitable skill based courses to qualify for Diploma.**

| Exit Options to Qualify for UG Diploma in ECIE: Any Two (02) Skill based Courses -: | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S. No. | Category | Course Code | Course Title | L | T | P | O | E | C |
| 1 | SEC | U24SE412XCI | Data Communication and Networking | - | - | 6 | - | 6 | 3 |
| 2 | SEC | U24SE413XCI | Electronics Servicing and Maintenance | - | - | 6 | - | 6 | 3 |
| 3 | SEC | U24SE414XCI | Advanced PCB Designing ntsc_hyd_detail_24082022_electronic.pdf (nsic.co.in) | - | - | 6 | - | 6 | 3 |
| 4 | SEC | U24SE415XCI | Android APP Development Microsoft Word - 5. SOFWARE I 2022-23_ENG_HINDI (nsic.co.in) | - | - | 6 | - | 6 | 3 |
| 5 | SEC | U24SE416XCI | Any other skill based course approved by BoS Chair and Dean AA | - | - | 6 | - | 6 | 3 |

**B. Tech Honours with Research:**

**Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-I (5 Credits) at respective department during the summer vacation after IV Semester.**

# INTRODUCTION TO MICROCONTROLLERS AND EMBEDDED SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV Semester Exit Course | | **Branch:** ECI | |
| **Course Code:** | **U24CI412X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **32 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

***LO5:*** *architecture and addressing modes of 8051*

***LO6:*** *microcontroller hardware units and interfacing keyboards, display with 8051*

***LO7:*** *overall design issues related to hardware and software of an embedded system*

***LO8:*** *basic functions of OS, multiprocessing and multitasking, task scheduling, synchronization*

**THEORY COMPONENT**

| **UNIT-I** | **4 Hrs** |
|---|---|

**8051 Microcontroller:** Architecture, Memory organization, Programming model, Addressing modes, Instruction set

| **UNIT-II** | **4 Hrs** |
|---|---|

**8051 Microcontroller:** I/O ports, Timers and counters, Serial data input and output, Microcontroller interfacing with keyboard & display Units (LED and LCD)

| **UNIT-III** | **4 Hrs** |
|---|---|

**Embedded System:** Introduction, Characteristics and components of an embedded system, Fundamental issues in hardware software co-design, Embedded firmware design approaches

| **UNIT-IV** | **4 Hrs** |
|---|---|

**Real-Time Operating System (RTOS) based Embedded System Design:** Operating system basics, Tasks, Process & threads, Multiprocessing and multitasking, Task scheduling, Task communication, Task synchronization

**LABORATORY COMPONENT**

**List of Programs**

1. ALPs / ECPs (Embedded C Programs) for implementing arithmetic operations (Multiplication, Division) on single and double precision binary data
2. ALP / ECP for searching largest number in an array
3. ALP / ECP for searching smallest number in an array
4. ALP / ECP for interfacing switches
5. ALP / ECP for matrix key board interfacing
6. ALP / ECP for interfacing LEDs
7. ALP / ECP for 7-Segment display interfacing
8. ALP / ECP for LCD interfacing
9. ALP / ECP for DAC interfacing
10. ALP / ECP for ADC interfacing
11. ALP / ECP for interfacing DC motor

12. ALP/ECP for interfacing stepper motor

**Textbook(s):**

1. Manish K Patel, *The 8051 Microcontroller Based Embedded Systems*, New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2014. *(Chapter 2 to 21)*
2. Shibu K V, *Introduction to Embedded Systems,* New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2009. *(Chapter 1, 2, 5, 6, 7, 9 and 10)*

**Reference Book(S):**

1. Kenneth J. Ayala, *The 8051 Microcontroller*, 3rd ed., Noida: Cengage learning, 2007
2. Md. Ali Mazidi, Janice G Mazidi and Rolin D. McKinlay, *The 8051 Microcontroller and Embedded Systems Using Assembly and C*, 2nd ed., New Delhi: Pearson Education India, 2011.
3. Sriram V. Iyer & Pankaj Gupta, *Embedded Real Time Systems Programming*, New Delhi: TMH, 2003.

**Web and Video link(s):**

***https://onlinecourses.nptel.ac.in/noc25_ee49/preview, NPTEL Video Lecture on*** *Microprocessors and Microcontrollers by Prof. Santanu Chattopadhyay IIT Kharagpur*

**Laboratory Manual (for laboratory component):**

1. *Microcontrollers and Embedded Systems laboratory manual and record book,* Department of ECIE, KITSW

Course Learning Outcomes (COs)

*After completion of this course, the students should be able to,*
*(based on cognitive skills acquired from theory component)*

CO1: identify the key architectural features of 8051 microcontroller
CO2: develop hardware and software for interfacing keyboards, display units
CO3: interpret design issues related to hardware and software of an embedded system
CO4: select appropriate task scheduling algorithms and solve synchronization issues

*(based on psychomotor skills acquired from laboratory component)*

CO5: develop arithmetic, logical & data processing algorithms using 8051 assembly language
CO6: develop algorithms for sorting using 8051assembly language
CO7: develop ALPs & ECPs for interfacing input output devices with 8051
CO8: develop ALPs & ECPs for interfacing data converters with 8051

| Course Articulation Matrix (CAM): | | U24CI412.X INTRODUCTION TO MICROCONTROLLERS AND EMBEDDED SYSTEMS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CI412.X.1 | 1 | 1 | 2 | 1 | 2 | - | 1 | - | 1 | - | 1 | 2 | 2 |
| CO2 | U24CI412.X.2 | 1 | 1 | 2 | 1 | 2 | - | 1 | - | 1 | - | 1 | 2 | 2 |
| CO3 | U24CI412.X.3 | 1 | 1 | 2 | 1 | 2 | - | 1 | - | 1 | - | 1 | 2 | 2 |
| CO4 | U24CI412.X .4 | 1 | 1 | 2 | 1 | 2 | - | 1 | - | 1 | - | 1 | 2 | 2 |
| CO5 | U24CI412.X .5 | 1 | 1 | 2 | 1 | 2 | - | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO6 | U24CI412.X .6 | 1 | 1 | 2 | 1 | 2 | - | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO7 | U24CI412.X .7 | 1 | 1 | 2 | 1 | 2 | - | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO8 | U24CI412.X .8 | 1 | 1 | 2 | 1 | 2 | - | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| U24CI412.X | | 1 | 1 | 2 | 1 | 2 | - | 1 | 2 | 1.5 | 1 | 1 | 2 | 2 |
| 3-High, 2-Medium, 1-Low | | | | | | | | | | | | | | |

# FUNDAMENTALS OF INTERNET OF THINGS

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV semester Exit course | | **Branch:** ECI | |
| **Course Code:** | **U24CI413X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **32 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

***LO1:*** fundamentals of IoT and domain specific IoT systems

***LO2:*** IoT protocols and platform design methodology

***LO3:*** IoT devices (*Arduino UNO and Node MCU boards*) and their programming

***LO4:*** cloud computing for IoT

**THEORY COMPONENT**

| **UNIT-I** | **4 Hrs** |
|---|---|

**Internet of Things (IoT):** Introduction, Characteristics, Ecosystem, Layered structure, Reference model, Enabling technologies

**Domain specific IoT systems**: Home automation, Smart cities, Environment, Retail, Logistics, Agriculture

| **UNIT-II** | **4 Hrs** |
|---|---|

**IoT Protocols:** MQTT, XMPP, DDS, AMQP, COAP, REST

**IoT platform design methodology:** Procedural steps of IoT platform design methodology

| **UNIT-III** | **4 Hrs** |
|---|---|

**Building blocks of Arduino device:** Introduction to Arduino board and Node MCU board, Arduino boards architecture & pin diagram, Arduino board interfaces, Arduino based IoT interfacing circuits with sensors, actuators, LCD & LED display devices

**Programming for IoT applications:** Programming with IoT devices - Arduino, Node MCU; IoT applications - Controlling LED, Measurement of temperature and humidity using DHT sensor, Obstacle detection and distance measurement using ultrasonic sensor, Actuating alarm buzzer & push button switch, Controlling servo motor

| **UNIT-IV** | **4 Hrs** |
|---|---|

**Cloud computing for IoT**: Introduction to cloud computing, fog computing and edge computing; Cloud service models – SaaS, PaaS & IaaS; Cloud deployment models – Public, private, hybrid & community clouds; Cloud security, Introduction to ThingsBoard cloud platform

**LABORATORY COMPONENT**

**List of Experiments**

1. LED interface with Arduino UNO
2. LCD display interface with Arduino UNO
3. Relay interface with Arduino UNO
4. Varying brightness of LED with Arduino UNO
5. IR sensor interface with Arduino UNO
6. Servo motor interface with NodeMCU

7. Obstacle detection using NodeMCU
8. Pulse sensor interface with NodeMCU
9. Humidity and temperature measurement using NodeMCU
10. Remote monitoring of sensor data using Things board cloud

**Textbook(s):**

1. Srinivasa K.G. et al., *Internet of Things,* 2nd ed., Cengage Learning India Pvt. Ltd., 2019. (*Chapters 1, 3, 4, 5 & 7*)
2. S. Misra, A. Mukherjee, and A. Roy, *Introduction to IoT,* 1st ed., Cambridge University Press, 2020. (*Chapters 5, 10, 11, 12, 13, 14 & 16*)

**Reference Book(s):**

1. Bahga and V. Madisetti, *Internet of Things: A Hands-on Approach*, 1st ed., Universities Press (India) Pvt. Ltd., Reprint (2020), 2014.
2. Colin Dow, *Internet of Things Programming Projects*, Birmingham: Packt Publishing Pvt Ltd., 2018.
3. Bahga and V. Madisetti, *Cloud Computing: A Hands-on Approach*, 1st ed., Universities Press (India) Pvt. Ltd., Reprint (2022), 2014.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview; NPTEL Video Lecture on *Introduction to Internet of Things* by Prof. Sudip Misra, *Professor of CSE,* IIT Kharagpur.

**Laboratory Manual (for laboratory component):**

1. *Fundamentals of IoT Laboratory Manual and Record Book,* Department of ECIE, KITSW.

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1**: utilize IoT reference model & enabling technologies to develop domain specific IoT systems

**CO2**: identify IoT protocols and select appropriate design methodology to develop domain specific IoT systems

**CO3**: develop Arduino based programs for IoT applications

**CO4**: apply cloud computing concepts to develop IoT systems

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: measure temperature, humidity & distance using NodeMCU

**CO6**: build LED & LCD interfacing circuits using Arduino UNO

**CO7**: build interfacing circuit for servo motor using NodeMCU

**CO8**: develop programs to store & retrieve the data using cloud

| Course Articulation Matrix (CAM): | | U24CI413X FUNDAMENTALS OF INTERNET OF THINGS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24CI413X.1 | 2 | 1 | 1 | 1 | - | - | 1 | 1 | 1 | - | 1 | 2 | 2 |
| CO2 | U24CI413X.2 | 2 | 1 | 1 | 1 | - | - | 1 | 1 | 1 | - | 1 | 2 | 2 |
| CO3 | U24CI413X.3 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 2 | 2 |
| CO4 | U24CI413X.4 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 2 | 2 |
| CO5 | U24CI413X.5 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO6 | U24CI413X.6 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO7 | U24CI413X.7 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO8 | U24CI413X.8 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **U24CI413X** | | **1.5** | **1** | **1.5** | **1** | **1.67** | **1** | **1** | **1.5** | **1.5** | **1** | 1 | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PRINTED CIRCUIT BOARD DESIGN

| | | | |
|---|---|---|---|
| **Class:** B.Tech. IV –Semester Exit course | | **Branch:** ECI | |
| **Course Code:** | **U24CI414X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE:** | **60 %** |
| **Total Number of Teaching Hours:** | **32 Hrs** | **ESE:** | **40 %** |

**Course Learning Objectives (LOs):**

*This course will develop students' knowledge in /on…*

**LO1:** classification of Printed Circuit Boards (PCBs)
**LO2:** PCB layout techniques for optimized component density and power saving
**LO3:** etching and soldering techniques in PCB design
**LO4:** current trends in PCB industry

**THEORY COMPONENT**

| **UNIT-I** | **4 Hrs.** |
|---|---|

**PCB Fundamentals**: Introduction, Components of PCB, Electronic components, Microprocessors and microcontrollers, ICs, Surface Mount Devices (SMD); Classification of PCBs - Single-sided, Double-sided, Multilayer & flexible; Manufacturing of PCB, PCB standards

| **UNIT-II** | **4 Hrs.** |
|---|---|

**Schematic and Layout Design:** Schematic diagram, Design considerations, Placing and mounting of components, Conductor spacing, Routing guidelines, Heat sinks and package density, Net list, Creating components for a library, Tracks, Pads, Vias, Power plane, Grounding

| **UNIT-III** | **4 Hrs.** |
|---|---|

**PCB Design Processes:** Design automation, Design rule checking, Exporting drill and Gerber files, Drills, Footprints and libraries, Adding and editing pins, Copper-clad laminates, Properties of laminates (electrical & physical), Etching techniques, Lead cutting and soldering techniques

| **UNIT-IV** | **4 Hrs.** |
|---|---|

**PCB Technology**:
Introduction of PCB prototyping machines, Schematic entry, PCB parts creation, Auto routing, Post design, Brief overview of various models, Recent trends, Environmental concerns in the PCB industry

**LABORATORY COMPONENT**

**List of Experiments**

**PCB layout design of**

1. P-N junction diode circuit to study V-I characteristics
2. Full wave rectifier circuit with filters
3. Zener regulator circuit
4. CE amplifier circuit
5. Op-Amp integrator circuit
6. Astable multivibrator circuit using IC 555
7. Full adder circuit using NAND gates
8. Decade ripple counter using T-Flip flops

**PCB Design Softwares recommended**

1. KiCAD (Open-Source Electronics Design Automation Suite) https://www.kicad.org/
2. EasyEDA (Online PCB Design Tool) https://easyeda.com/
3. PADS - Siemens EDA (PCB Design Software) https://eda.sw.siemens.com/en-US/pcb/pads/

**Textbook(s):**

1. Walter C. Bosshart, *Printed Circuit Board – Design & Technology*, New Delhi : Tata McGraw- Hill, 2008.

**Reference Book(S):**

1. R.S. Khandpur, *Printed Circuit Board –Design, Fabrication, Assembly & Testing,* 1st ed., Tata McGraw-Hill, 2005.
2. Chris Schroeder, *Printed Circuit Board Design Using Autocad*, Newnes Publisher, 1998.
3. Clyde F. Coombs, Jr, Happy T. Holden, *Printed Circuits Handbook*, 6th ed., New Delhi: McGraw Hill, 2016.

**Web and Video link(s):**

1. https://youtube.com/playlist?list=PL_UUrUkFMWRXeJ2mKt5jidU5hId4gwY&si=VotSJBjFbp3LWMaV.

**Laboratory Manual (for laboratory component):**

1. *PCB Design and Fabrication laboratory manual and record book,* Department of ECIE, KITSW

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1**: classify PCBs

**CO2**: develop the schematic and layouts for PCB circuits
**CO3**: illustrate the PCB design and automation process
**CO4:** appraise the current trends in PCB design industry

*(based on psychomotor skills acquired from laboratory component)*

**CO5**: design **PCB** to test the functionality of full wave rectifier circuit
**CO6**: design **PCB** to test the functionality of Zener regulator circuit
**CO7**: design **PCB** to test the functionality of analog circuits
**CO8**: design **PCB** to test the functionality of digital circuits

| Course Code: **U24CI414X** Course Name**: PRINTED CIRCUIT BOARD DESIGN** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| CO1 | **U24CI414X.1** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| CO2 | **U24CI414X.2** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| CO3 | **U24CI414X.3** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| CO4 | **U24CI414X.4** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | - | 1 | - | 1 | 2 | 2 |
| CO5 | **U24CI414X.5** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO6 | **U24CI414X.6** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO7 | **U24CI414X.7** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| CO8 | **U24CI414X.8** | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 |
| **U24CI414X** | | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 2 | 1.5 | 1 | 1 | 2 | 2 |

# B.TECH. CURRICULUM & SYLLABI

## (V SEM TO VIII SEM)

**w.e.f ACADEMIC YEAR: 2026–27**

## ELECTRONICS COMMUNICATION AND INSTRUMENTATION ENGINEERING (ECI)

Undergraduate Rules and Regulations-2024 (**URR24**)
**In accordance with the National Education Policy 2020**
**w.e.f AY 2026-27**

**Regulations Governing the**
**Choice Based Credit System and**
**Multiple Entry and Multiple Exit Options**
**with**
**Competency-Focused Outcome Based Curriculum (CF-OBC)**

**DEPARTMENT OF ECIE**

*KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 506 015 TELANGANA*

***(UGC Autonomous Institute Under Kakatiya University, Warangal)***

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
website: www.kitsw.ac.in E-mail: principal@kitsw.ac.in ✆ : +91 9392055211, +91 7382564888

# Semester -V Syllabi

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | OE | U24OE501X | Open Elective – Startup & Entrepreneurship Basket (OE-S&EB) | 2 | 1 | - | 3 | 3 |
| 2 | PCC | U24CI502 | Internet of Things | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI503 | Microcontrollers and Embedded Systems | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI504 | Artificial Intelligence and Machine Learning | 2 | 1 | - | 3 | 3 |
| 5 | ESC | U24CI505 | Linear Control Systems | 2 | 1 | - | 3 | 3 |
| 6 | IKSC | U24IK506A | Essence of Indian Traditional Knowledge | 2 | - | - | 2 | 2 |
| 7 | HSMC | U24MH507 | Technical English | - | - | 2 | 2 | 1 |
| 8 | PCC | U24CI508 | Microcontrollers and Embedded Systems Lab | - | - | 2 | 2 | 1 |
| 9 | PCC | U24CI509 | AIML Applications Lab | - | - | 2 | 2 | 1 |
| 10 | ELC | U24CI510 | Seminar | - | - | 2 | 2 | 1 |
| **Total:** | | | | **12** | **5** | **8** | **25** | **21** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 26 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

| Open Elective - Startup & Entrepreneurship Basket (OE-S&EB) | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24OE501A | Design Thinking |
| 2. | U24OE501B | Innovative Product Design and Development |
| 3. | U24OE501C | Entrepreneurship |
| 4. | U24OE501D | Design Studio |
| 5. | U24OE501E | *Any other course approved by BoS Chair and Dean AA* |

# DESIGN THINKING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V- Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE501A** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to…*

**CO1:** identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks

**CO2:** analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions

**CO3:** develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies

**CO4:** evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching

| **UNIT-I** | **9 Hrs** |
|---|---|

**Identify and Analyze Real-world Problems:** The Macro Industry View, Problem Identification & Segment Assembly, Customer Identification & Needs Validation, Assess 'Jobs-To-Be-Done' (JTBD) for a Customer Segment, Develop Customer Persona, Validate Customer-Problem fit, Pivot/Refine Customer-Problem fit for feasibility, Examine Ideation Techniques

| **UNIT-II** | **9 Hrs** |
|---|---|

**Solution Idea Generation & MVP:** Opportunity & Competition Mapping, Prototype Development & Minimum Viable Product (MVP), Identify Global Competitors, Review Industry Trends and Estimate Market Size (TAM), Introduction to Financial Planning, Overview of Prototypes & MVP, Build an initial Prototype, Prototypes for Early Validation, Map your Relative Position in the Market, Estimate Opportunity Size

| **UNIT-III** | **9 Hrs** |
|---|---|

**Market Feasibility & Business Modeling:** Lean Canvas Assembly, Marketing & Go-To-Market (GTM) Strategy, Examine Revenue Models, Review and Organize Lean Canvas, Build LC for your Start-up, Build LC for your Start-up, Understand Marketing and Sales, Recommend a GTM Approach, Map a Sales Process, Building an Initial Team

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Financial Management, Team Scale & Final Pitch:** Funding Pathways & Scaling Orientation, Validation & Venture Presentation/Collaboration, Deep Dive into Financial Planning, Analyse the Path to Profitability, Understand Bootstrapping & Funding Options, Finding Co-Founders and Mentors, Thinking Beyond the Prototype - Scale Opportunity & Orientation, Final Milestone - Venture Idea Feasibility Presentation

**Textbook(s):**

1. Chandramouli Subramanian & Thiyagarajan p, Sankaran V, Design Thinking: A Hands-on Approach, University Press (India) Pvt. Ltd., 1st Edn., 2025, Hyderabad.

**Reference Book(s):**

1. Andrew Pressman, Design Thinking: A Guide to Creative Problem Solving for Everyone, Routledge, Taylor & Francis Group, 7th Edn., 2019, New York.
2. George E. Dieter and Linda C. Schmidt, Engineering Design, McGraw-Hill Education, 13th ed., 2020, New Delhi.
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperBusiness, 7th Edn., 2009, New York.
4. Karl T. Ulrich, Steven D. Eppinger, and Maria C. Yang, Product Design and Development, McGraw-Hill Education, 2020, New Delhi.
5. Tom Kelley and David Kelley, Creative Confidence: Unleashing the Creative Potential Within Us

All, Crown Business, 2013, New York.
6. Idris Mootee, Design Thinking for Strategic Innovation, John Wiley & Sons, 1st Edn., 2013, New Jersey.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/110106124; *NPTEL Video Lecture on Design Thinking - A Primer by Prof. Ashwin Mahalingam & Prof. Bala Ramadurai, IIT Madras*.

| Course Articulation Matrix (CAM): | | U24OE501A - Design Thinking | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO10 | PO11 | PSO1 | PSO 2 |
| CO1 | U24OE501A.1 | 2 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 1 | 2 | 2 |
| CO2 | U24OE501A.2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | 2 | 2 |
| CO3 | U24OE501A.2 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| CO4 | U24OE501A.2 | 1 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| **U24OE501A** | | **1.25** | **1.75** | **2.25** | **1.75** | **1.5** | **1.25** | **1** | **1.25** | **1.25** | **1.5** | **1.25** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify customer segments and needs, assess customer-problem fit using Jobs-to-be-Done (JTBD) and customer persona frameworks | **SDG 4** | **Quality Education** | Promotes creative learning, problem-solving, and innovation skills among students. |
| | | **SDG 9** | **Industry, Innovation and Infrastructure** | Encourages innovative thinking for solving engineering and societal challenges. |
| **CO2** | analyze market opportunities and competitive dynamics, estimate business feasibility and build prototypes/MVPs for validating innovative solutions | **SDG 3** | **Good Health and Well-being** | Human-centered design improves usability, safety, and user well-being. |
| | | **SDG 11** | **Sustainable Cities and Communities** | Supports identification of sustainable and community-oriented solutions. |
| **CO3** | develop a Lean Canvas for a start-up venture by integrating value proposition, customer segments, revenue streams, key metrics and growth strategies | **SDG 9** | **Industry, Innovation and Infrastructure** | Promotes innovation, product development, and technological advancement. |
| | | **SDG 12** | **Responsible Consumption and Production** | Encourages efficient resource utilization and sustainable product development. |
| **CO4** | evaluate funding and team-building strategies and develop a scalable, investment-ready venture proposal through financial planning, validation and professional pitching | **SDG 8** | **Decent Work and Economic Growth** | Supports entrepreneurship, innovation-driven business models, and employability skills. |
| | | **SDG 9** | **Industry, Innovation and Infrastructure** | Encourages development of practical and scalable engineering solutions. |
| | | **SDG 17** | **Partnerships for the Goals** | Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction. |

# INNOVATIVE PRODUCT DESIGN & DEVELOPMENT

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V- Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE501B** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to…*

**CO1:** create the systematic lifecycle of engineering design from customer requirements to technical specifications

**CO2:** choose principles of industrial design, materials science, and ergonomics to optimize product usability

**CO3:** implement the advanced rapid prototyping tools to compress the product development cycle

**CO4:** design and build prototype performance using structural validation, risk analysis, and engineering metrics

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Product Design Engineering:** Translating user needs into Product Design Specifications (PDS), Quality Function Deployment (QFD), House of Quality framework, Functional decomposition and physical architecture mapping, Regulatory compliance, standards, and safety considerations in product architecture

| **UNIT-II** | **9 Hrs** |
|---|---|

**Principles of Industrial Design (ID):** Human-centered design and Ergonomics (Anthropometry), Visual hierarchy, form generation, and product aesthetics, Material selection frameworks- Structural, Thermal, Electrical properties; Manufacturing process mapping - DFM/DFA: Design for Manufacturing and Assembly), Design semantics and user-interface touchpoints

| **UNIT-III** | **9 Hrs** |
|---|---|

**Prototyping Strategies, Proof-of-concept vs. Alpha/beta Prototypes**: Additive manufacturing- 3D Printing, FDM, SLA, SLS; Subtractive techniques (CNC machining), Rapid tooling, Silicone moulding, Vacuum forming, Digital prototyping- Computer-Aided Design (CAD) modeling, Assembly verification, Finite element simulations; Virtual and Augmented Reality (VR/AR) workflows for product spatial validation

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Design of Experiments (DoE) for Physical/Digital Prototypes**: Robust design testing and failure analysis, Cost modelling, Bill of Materials (BOM) management, Engineering change orders (ECO), Sustainable engineering- Design for Environment (DFE), Lifecycle evaluation; Preparing the product blueprint for production scaling and supply chain onboarding

**Textbook(s):**


1. Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development*, Tata McGraw-Hill, 10th ed., 2012, New Delhi.


**Reference Book(s):**


1. Devdas Shetty, *Product Design for Engineers*, Cengage Learning, 9th ed., 2015, Boston.
2. A.K. Chitale and R.C. Gupta, *Product Design and Manufacturing*, PHI Learning, 2013, 13th ed., New Delhi.
3. Kevin Otto and Kristin Wood, *Product Design: Techniques in Reverse Engineering and New Product Development,* Pearson Education, 2001, New Delhi.
4. Benjamin W. Niebel and Alan B. Draper, *Product Design & Process Engineering*, McGraw-Hill, 1974, New York.
5. Paul Trott, *Innovation Management and New Product Development*, Pearson Education, 2016, Harlow.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/112107217; *NPTEL Video Lecture on Product Design and Development by Prof. Inderdeep Singh, Professor of Mechanical and Industrial Engineering, IIT Roorkee*

| **Course Articulation Matrix (CAM):** | | **U24OE501B - Innovative Product Design & Development** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24OE501B.1** | 2 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 1 | 2 | 2 |
| **CO2** | **U24OE501B.2** | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | 2 | 2 |
| **CO3** | **U24OE501B.3** | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| **CO4** | **U24OE501B.4** | 1 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 1 |
| **U24OE501B** | | **1.25** | **1.75** | **2.25** | **1.75** | **1.5** | **1.25** | **1** | **1.25** | **1.25** | **1.5** | **1.25** | **1.75** | **1.75** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | create the systematic lifecycle of engineering design from customer requirements to technical specifications | **SDG 4** | Quality Education | Promotes creative learning, problem-solving, and innovation skills among students. |
| | | **SDG 9** | Industry, Innovation and Infrastructure | Encourages innovative thinking for solving engineering and societal challenges. |
| **CO2** | choose principles of industrial design, materials science, and ergonomics to optimize product usability | **SDG 3** | Good Health and Well-being | Human-centered design improves usability, safety, and user well-being. |
| | | **SDG 11** | Sustainable Cities and Communities | Supports identification of sustainable and community-oriented solutions. |
| **CO3** | implement the advanced rapid prototyping tools to compress the product development cycle | **SDG 9** | Industry, Innovation and Infrastructure | Promotes innovation, product development, and technological advancement. |
| | | **SDG 12** | Responsible Consumption and Production | Encourages efficient resource utilization and sustainable product development. |
| **CO4** | design and build prototype performance using structural validation, risk analysis, and engineering metrics | **SDG 8** | Decent Work and Economic Growth | Supports entrepreneurship, innovation-driven business models, and employability skills. |
| | | **SDG 9** | Industry, Innovation and Infrastructure | Encourages development of practical and scalable engineering solutions. |
| | | **SDG 17** | Partnerships for the Goals | Promotes teamwork, interdisciplinary collaboration, and stakeholder interaction. |

# ENTREPRENEURSHIP

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V- Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE501C** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to…*

**CO1:** develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility

**CO2:** analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques

**CO3:** create students with practical knowledge of business modeling, unit economics, and venture monetization

**CO4:** build a clear roadmap for executing, legally safeguarding, and pitching a new venture

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Entrepreneurship**: Definition, Characteristics, Evolution of an entrepreneurial ecosystem; Myths vs. Realities of starting up; Types of Entrepreneurship- Social, Tech, Lifestyle, and Corporate

**Developing an Entrepreneurial Mindset:** risk-taking, resilience, self-efficacy, and dealing with failure; Identifying personal strengths and alignment with venture archetypes

| **UNIT-II** | **9 Hrs** |
|---|---|

**Deep-dive Problem Identification:** Moving from generic ideas to systemic problems; Root-cause analysis, Stakeholder mapping, Ecosystem friction points

**Customer Discovery Methodology:** Conducting ethnographic interviews, Building user personas, Mapping customer archetypes, Validating market pain points vs. "nice-to-have" solutions, Value Proposition Canvas framework

| **UNIT-III** | **9 Hrs** |
|---|---|

**Designing the Business Architecture:** Introduction to the Lean Canvas and Business Model Canvas (BMC), Revenue streams, Pricing strategies, Cost structures

**Fundamentals of Unit Economics:** Customer Acquisition Cost (CAC), Lifetime Value (LTV) and break-even analysis, Competitor analysis and establishing a Sustainable competitive advantage (MOAT), Basics of bootstrapping vs. external funding

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Building the Go-To-Market (GTM) strategy:** Marketing channels, Sales funnels and early user acquisition, Basics of business registration, legal structures (LLP, Pvt Ltd) and intellectual property (IP) awareness, Building an early founding team, Equity splitting models and culture, Final capstone venture pitch preparation- Structuring an investor pitch deck

**Textbook(s):**


1. Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd, Entrepreneurship, McGraw-Hill Education, 1st Edn, 2020, New Delhi.


**Reference Book(s):**


1. Poornima M. Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 5th Edn, 2018, New Delhi.
2. Bruce R. Barringer and R. Duane Ireland, Entrepreneurship: Successfully Launching New Ventures, Pearson, 4th Edn, 2019, New Delhi.
3. Eric Ries, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation, Crown Business, 2011, New York.
4. S. S. Khanka, Entrepreneurship Development, S. Chand & Company, 2010, New Delhi.

5. Peter Thiel, Zero to One: Notes on Startups, or How to Build the Future, Crown Business, 2014, New York.

**Web and Video link(s):**

https://nptel.ac.in/courses/110105067; *NPTEL Video Lecture on Entrepreneurship Essentials by Prof. Rajeev Roy, Entrepreneurship Development Cell, IIT Kharagpur*.

| **Course Articulation Matrix (CAM):** | | **U24OE501C - Entrepreneurship** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24OE501C.1** | 2 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 1 | 1 | 1 |
| **CO2** | **U24OE501C.2** | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 1 |
| **CO3** | **U24OE501C.3** | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CO4** | **U24OE501C.4** | 1 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| **U24OE501C** | | **1.25** | **1.75** | **2.25** | **1.75** | **1.5** | **1.25** | **1** | **1.25** | **1.25** | **1.5** | **1.25** | **1.25** | **1.25** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO 1** | develop an entrepreneurial mindset and create scalable business concepts through the analysis of opportunities and evaluation of business feasibility | **SDG4** | Quality Education | Enhances entrepreneurial learning by fostering creativity, critical thinking, and practical problem-solving skills |
| | | **SDG9** | Industry, Innovation and Infrastructure | Promotes innovation and entrepreneurship by encouraging the development of scalable ventures that contribute to industrial and technological growth |
| **CO 2** | analyze and validate customer needs, market demands, and pain points using structured customer discovery techniques | **SDG3** | Good Health and Well-being | Facilitates the identification and validation of healthcare-related needs, leading to more user-centric and impactful well-being solutions |
| | | **SDG11** | Sustainable Cities and Communities | Supports the development of community-focused innovations by understanding urban challenges and designing solutions aligned with citizens' needs |
| **CO 3** | create students with practical knowledge of business modeling, unit economics, and venture monetization | **SDG9** | Industry, Innovation and Infrastructure | Strengthens innovation ecosystems by enabling the commercialization and scaling of technology-driven ventures |
| | | **SDG12** | Responsible Consumption and Production | Encourages sustainable business practices by integrating resource efficiency, value creation, and responsible production principles into venture planning |
| **CO 4** | build a clear roadmap for executing, legally safeguarding, and pitching a new venture | **SDG8** | Decent Work and Economic Growth | Promotes entrepreneurship and job creation by enabling the successful launch and growth of innovative ventures. |
| | | **SDG9** | Industry, Innovation and Infrastructure | Supports innovation-driven enterprises by facilitating the protection, development, and scaling of new technologies and business models |
| | | **SDG17** | Partnerships for the Goals | Encourages collaboration with investors, industry partners, mentors, and institutions to strengthen venture growth and impact. |

# DESIGN STUDIO

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V- Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE505D** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to…*

**CO1:** deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search & prior-art techniques

**CO2:** apply system-level architecture & feasibility models to design technical solutions

**CO3:** build & synthesize functional prototypes/MVPs leveraging modern engineering tools

**CO4:** validate engineering assumptions via stakeholder co-creation & design an institutional go-to-market plan

| **UNIT-I** | **9 Hrs** |
|---|---|

**Foundations of R&D-led entrepreneurship;** Identifying deep-tech and high-impact industry problems, Advanced root-cause analysis, Literature review, patent landscaping and prior art search, Defining the innovation thesis and scientific/technological core, Drafting the initial product design brief

| **UNIT-II** | **9 Hrs** |
|---|---|

**Translating insights into technical concepts**; Systematic brainstorming and TRIZ (Theory of Inventive Problem Solving) basics, Technology readiness level (TRL) mapping, Engineering/architectural design and system topology, Value proposition design and business-technical feasibility modeling, The "Napkin Pitch" for technical solutions

| **UNIT-III** | **9 Hrs** |
|---|---|

**Rapid prototyping paradigms (Software/Hardware/Service)**; Formulating the Minimum Viable Product (MVP) core feature matrix, Materials selection and Agile development sprints, UI/UX wireframing or hardware schematics, Functional architecture implementation, Risk assessment and failure mode effects analysis (FMEA)

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Surface key engineering and market assumptions;** Empirical testing protocols, Simulation, Data collection, Customer co-creation loops and iterative engineering; Feedback analysis from key industry stakeholders, Creating the product "On-Ramp" strategy (Go-To-Market roadmap, Pilot launch framework, and IP Protection)

**Textbook(s):**


1. Brian Sullivan, *The Design Studio Method: Creative Problem Solving with UX Sketching,* Routledge, 2015, New York.


**Reference Book(s):**


1. Elizabeth Boling, James Benedict Brown, Colin M. Gray, and Derek Jones, *Studio Properties: A Field Guide to Design Education*, Yale Press, 2021, New Haven.
2. Charles Eastman, W. Michael McCracken, and Wendy Newstetter, *Design Knowing and Learning: Cognition in Design Education*, Elsevier, 2001, Oxford.
3. Donald A. Schön, *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions*, Jossey-Bass, 17th ed., 1987, San Francisco.
4. Jerzy Wojtowicz, *Virtual Design Studio*, Hong Kong University Press, 8th ed., 1995, Hong Kong.
5. Lois Hetland and Ellen Winner, *Studio Thinking: The Real Benefits of Visual Arts Education*, Teachers College Press, 12th ed., 2007, New York.


**Web and Video link(s):**

1. https://nptel.ac.in/courses/124105003; *NPTEL Video Lecture on Understanding Design by Prof.*

*Prasad Onkar, Department of Design, IIT Hyderabad.*

| Course Articulation Matrix (CAM): | | U24OE505D/U24OE605D - Design Studio | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
| CO1 | U24OE505D.1 | 2 | 2 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 1 | 1 | 2 |
| CO2 | U24OE505D.2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | 2 |
| CO3 | U24OE505D.3 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| CO4 | U24OE505D.4 | 1 | 1 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 1 | 1 |
| U24OE505D | | 1.25 | 1.75 | 2.25 | 1.75 | 1.5 | 1.25 | 1 | 1.25 | 1.25 | 1.5 | 1.25 | 1 | 1.75 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| CO | Course Outcome | Mapped SDGs | | Justification |
| CO1 | deconstruct ambiguous real-world problems into rigorous R&D challenges using patent search and prior-art techniques. | SDG 4 | Quality Education | Promotes experiential and innovation-based learning by equipping learners with problem-solving, research, and intellectual property skills essential for the 21st century |
| | | SDG 9 | Industry, Innovation and Infrastructure | Fosters innovation capacity by encouraging the development of novel technologies, strengthening industry-oriented research, and supporting sustainable technological advancement. |
| CO2 | apply system-level architecture and feasibility models to design technical solutions. | SDG 3 | Good Health and Well-being | Supports the design of reliable healthcare technologies and systems that enhance accessibility, efficiency, and overall well-being |
| | | SDG 11 | Sustainable Cities and Communities | Facilitates the creation of smart, resilient, and resource-efficient infrastructure solutions that improve urban sustainability and quality of life. |
| CO3 | build and synthesize functional high-fidelity prototypes / MVPs leveraging modern engineering tools. | SDG 9 | Industry, Innovation and Infrastructure | Promotes technological innovation and strengthens engineering capabilities by accelerating product development and industry-relevant solutions. |
| | | SDG 12 | Responsible Consumption and Production | Encourages efficient resource utilization, iterative design, and sustainable product development practices that minimize waste and optimize production processes. |
| CO4 | validate engineering assumptions via stakeholder co-creation and design an institutional go-to-market plan. | SDG 8 | Decent Work and Economic Growth | Supports entrepreneurship, innovation-driven employment, and sustainable economic growth through market-oriented solution development. |
| | | SDG 9 | Industry, Innovation and Infrastructure | Strengthens industry-academia innovation ecosystems by facilitating the translation of validated technologies into scalable solutions. |
| | | SDG 17 | Partnerships for the Goals | Encourages collaboration among academia, industry, government, and end users to co-create impactful and sustainable innovations. |

# INTERNET OF THINGS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI502** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

- **CO1:** identify the building blocks of networking including definitions, architectural layers & enabling technologies
- **CO2:** apply the architecture and programming of IoT hardware platforms such as NodeMCU and Raspberry Pi for GPIO interfacing and peripheral communication
- **CO3:** analyze the IoT protocol stack comprising infrastructure, service discovery, and application layer protocols for selecting appropriate communication solutions
- **CO4:** design IoT applications using RESTful APIs, MQTT, and cloud platforms for domains such as smart homes, healthcare, agriculture, and industrial automation

| **UNIT-I** | **9 Hrs** |
|---|---|

**Basics of networking:** Introduction, Network types, OSI model, Internet protocol suite, Data link layer addressing, Network layer addressing; TCP/IP transport layer- Connectionless service, Connection-oriented service

**Introduction to IoT:** Definition and characteristics of IoT, Things in IoT, IoT Architectural layers, IoT enabling technologies, IoT challenges, IoT levels, IoT building blocks

| **UNIT-II** | **9 Hrs** |
|---|---|

**Hardware Platforms:** Node MCU- Architecture, Programming and GPIO interfacing; Raspberry Pi – Architecture, OS installation, GPIO interfacing using python, Controlling servo motors, I2C & SPI communication, Essential Linux commands for Raspberry Pi

| **UNIT-III** | **9 Hrs** |
|---|---|

**IoT protocol stack:** Infrastructure Protocols- RFID, IEEE 802.15.4, EEE 802.11ah, BLE, Zigbee, Z-Wave, LoRa/LoRaWAN, NB-IoT, 5G for IoT, 6LowPAN, RPL; Service Discovery Protocols- mDNS, DNS-SD; Application Protocols- MQTT, CoAP, AMQP, XMPP, HTTP/HTTPS for IoT

| **UNIT-IV** | **9 Hrs** |
|---|---|

**IoT Application Development:** RESTful APIs & web socket services using Flask; Controlling brightness of an LED with python and MQTT; Creating, configuring and triggering of an IFTTT applet; Visualizing data with ThingSpeak platform

**IoT Application Domains:** Smart home automation, Smart healthcare and wearable devices, Smart agriculture and precision farming, Industrial IoT (IIoT) and Industry 4.0, Smart city applications, Connected vehicles and transportation

**Textbook(s):**


1. Muhammad Azhar Iqbal, Huanlai Xing et al, *Enabling the Internet of Things: Fundamentals, Design, and Applications,* John Wiley & Sons, 1st ed., NJ, 2021.
2. Gary Smart, *Practical Python Programming for IoT,* Packt Publishing, 1st ed., UK, 2020.


**Reference Book(s):**


1. Shriram K Vasudevan et al, *Internet of Things*, Wiley India, 2nd ed., India, 2020.
2. Sudip Misra et al, *Introduction to IoT*, Cambridge University Press, 1st ed., 2021.
3. Jeeva Jose, *Internet of Things,* Khanna Publishing, 1st ed., New Delhi, 2022.
4. Arshdeep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach,* Universities Press, India, 1st ed., 2014.


**Web and Video link(s):**

1. https://nptel.ac.in/courses/106105166; *NPTEL Video Lectures on Internet of Things by Prof.*

*Sudip Misra, IIT Kharagpur*

| Course Articulation Matrix (CAM): | | U24CI502: INTERNET OF THINGS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI502.1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO2 | U24CI502.2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO3 | U24CI502.3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO4 | U24CI502.4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| U24CI502 | | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement The student should be able to…** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify the building blocks of networking including definitions, architectural layers & enabling technologies | **SDG4** | Quality Education | Understanding networking architectures, communication models, and IoT foundations and develops technical competencies required for modern engineering education |
| **CO2** | demonstrate the architecture and programming of IoT hardware platforms such as NodeMCU and Raspberry Pi for GPIO interfacing and peripheral communication | **SDG9** | Industry, Innovation and Infrastructure | Demonstrating hands-on programming and interfacing of NodeMCU and Raspberry Pi platforms builds practical engineering competence in embedded IoT systems, by cultivating the technical skills needed to innovate, prototype, and deploy smart solutions across industrial and infrastructure domains |
| **CO3** | analyze the IoT protocol stack comprising infrastructure, service discovery, and application layer protocols for selecting appropriate communication solutions | **SDG11** | Sustainable Cities and Communities | Efficient communication technologies such as LoRaWAN, Zigbee, and NB-IoT enable large-scale smart-city deployments including traffic monitoring, waste management, and public infrastructure monitoring |
| **CO4** | design and build IoT applications using RESTful APIs, MQTT, and cloud platforms for domains such as smart homes, healthcare, agriculture, and industrial automation | **SDG2** | Zero Hunger | Designing IoT applications for smart agriculture and precision farming — using sensor data, automated irrigation, crop monitoring, and cloud dashboards, by improving food production efficiency and reducing waste. The inclusion of domains such as smart healthcare, IIoT further demonstrates the broad societal impact of applied IoT development |

# MICROCONTROLLERS AND EMBEDDED SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI503** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

## Course Learning Outcomes (COs)

*After completion of this course, the students should be able to,*

**CO1:** identify architectural features, viz. memory organization, interrupts and addressing modes of 8051 microcontroller

**CO2:** design required hardware interface and implement required software for interfacing keyboards, display units and data converters with 8051

**CO3:** develop embedded firmware using Embedded C for embedded applications

**CO4:** utilize real time operating system for task scheduling, inter task communication & synchronization

| **UNIT-I** | **9 Hrs** |
|---|---|

**Architecture of 8051 Microcontroller:** Overview of 8051 Microcontroller, 8051 Architecture, Hardware units of 8051, Memory organization, I/O ports, Timers and counters, Serial data input and output, Interrupts of 8051, 8051 Assembly language programming concepts, Addressing modes

| **UNIT-II** | **9 Hrs** |
|---|---|

**Programming model**: Instruction set of 8051 and programming, Assembly language programming for interfacing with switch, keyboard & display Units (LED and LCD), Interfacing of DAC and ADC, Serial data communication with UART, Use of interrupts & service routines

| **UNIT-III** | **9 Hrs** |
|---|---|

**Embedded System:** Introduction, Characteristics and components of an embedded system, Fundamental issues in hardware software co-design, Embedded firmware design approaches

**Programming in Embedded C:** 'C' vs. embedded C, compiler vs. cross compiler, Using 'C' in embedded C – data types, Data types for 8051 supported by Cx51 Compiler, Additional data types for the 8051, Accessing memory areas of the 8051, Bit addressable variables, Interrupt service routines 'using' attribute, Pointers, Pointers to absolute addresses, Programming in Embedded C for interfacing IO devices, Embedded C programs using Timers, UART & Interrupts

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Real-Time Operating System (RTOS):** RTOS based Embedded System Design: Operating system basics, Types of operating systems, Tasks, Process & threads, Multiprocessing and multitasking, Task scheduling, Task communication, Task synchronization, Device drivers, Selection of RTOS

**Textbook(s):**


2. Shibu K V, *Introduction to Embedded Systems*, New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2009. *(Chapter 1, 2, 5, 6, 7, 9 and 10)*
3. Manish K Patel, *The 8051 Microcontroller Based Embedded Systems*, New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2014. *(Chapter 2 to 21)*


**Reference Book(s):**


4. Kenneth J. Ayala, *The 8051 Microcontroller*, 3rd ed. Noida: Cengage learning, 2007.
5. Md. Ali Mazidi, Janice G Mazidi and Rolin D. McKinlay, *The 8051 Microcontroller and Embedded Systems Using Assembly and C*, 2nd ed. New Delhi: Pearson Education India, 2011.
6. Sriram V. Iyer & Pankaj Gupta, *Embedded Real Time Systems Programming*, New Delhi: TMH, 2003.


**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc26_ee58/preview; *NPTEL Video Lecture on Microprocessors and Microcontrollers by Prof. Santanu Chattopadhyaya, Professor of EE, IIT Kharagpur*
2. https://onlinecourses.nptel.ac.in/noc26_cs22/preview; *NPTEL Video Lecture on Introduction to Embedded System Design by Prof. Dhananjay V. Gadre, Netaji Subhas University of Technology & Prof. Badri Subudhi, IIT Jammu*

| **Course Articulation Matrix (CAM):** | | **U24CI503 MICROCONTROLLERS AND EMBEDDED SYSTEMS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO 10** | **PO 11** | **PSO1** | **PSO2** |
| CO1 | U24CI503.1 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO2 | U24CI503.2 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO3 | U24CI503.3 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO4 | U24CI503.4 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| **U24CI503** | | **3** | **2** | **3** | **1** | **1** | **2** | **3** | **2** | **2** | **1** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| CO1 | identify architectural features, viz. memory organization, interrupts and addressing modes of 8051 microcontroller | SDG4 | Quality Education | Understanding the 8051-core architecture and addressing modes is essential for developing the technical competency required for employment and entrepreneurship in the technology sector. It aligns with target 4.4, which focuses on increasing the number of youth and adults with relevant skills for decent jobs |
| CO2 | design required hardware design required hardware interface and implement required software for interfacing keyboards, display units and data converters with 8051 | SDG9 | Industry, Innovation and Infrastructure | Interfacing of IO devices such as Switches, Keyboards, LEDs, LCDs, Data Converters, etc., Microcontrollers interfacing with IO devices are the building blocks of "resilient infrastructure" and "inclusive and sustainable industrialization". Mastery of interfacing microcontrollers with peripheral devices allows engineers to design efficient embedded systems used in automation, smart grids, and industrial innovation |
| CO3 | develop embedded firmware using Embedded C for embedded applications | SDG11 | Sustainable Cities and Communities | Developing firmware for embedded applications for smart home, smart cities & communities through Embedded C programming |
| CO4 | utilize real time operating system for task scheduling, inter task communication & synchronization | SDG4 | Quality Education | This course directly supports Target 4.4, which aims to increase the number of youth and adults who have relevant skills, for employment and entrepreneurship. By teaching high-level engineering skills like RTOS design, the course prepares students for the modern digital workforce |

# ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI504** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** develop source code for data exploration & preprocessing using Python libraries

**CO2:** utilize supervised learning techniques for predictive modelling & performance evaluation

**CO3:** utilize unsupervised learning techniques to analyse unlabelled datasets

**CO4:** make use of neural networks, activation functions & optimization strategies to implement CNN

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** Evolution of Artificial Intelligence, Relationship between AI, Machine Learning and Deep Learning

**Python for Machine Learning:** Overview of Python libraries – NumPy, Pandas, Matplotlib, Seaborn

**Data Pre-processing:** Need for Data Pre-processing, Data collection, Data cleaning, Data Integration, Data Transformation, Data Reduction, Model selection, Training, Testing Features scaling- Normalization and Data visualization

| **UNIT-II** | **9 Hrs** |
|---|---|

**Supervised Learning – Regression:** Simple and Multiple Linear Regression, Performance Metrics- Mean Squared Error (MSE), $R^2$ Score

**Supervised Learning – Classification:** Types of classification, Decision Trees, Random Forest, Navie Bayes, k-Nearest Neighbour(k-NN), Logistic Regression, Support Vector Machine (SVM)

| **UNIT-III** | **9 Hrs** |
|---|---|

**Unsupervised Learning – Clustering and Dimensionality Reduction:** Introduction, Applications, Features, Distance metrics, Partitioning clustering- K-Means Clustering, Dimensionality Reduction- Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA)

**Ensemble learning:** Bagging -Random Forest, Boosting-AdaBoost, XGBoost, Case study on AdaBoost using Titanic Dataset from Kaggle

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Artificial Neural Networks:** Biological vs Artificial neuron, Need for neural networks, Building Blocks of Neural Network- Neuron model, Weights, bias, Layers (input, hidden, output); Activation & Loss Functions - Sigmoid, Tanh, ReLU, Softmax, Cross-Entropy, Mean Absolute Error (MAE); Implementation of Convolution neural networks (CNN)

**Optimizers & Training Process:** Gradient Descent Variants, Forward propagation, Back propagation (basic idea), Epochs, Iterations, Data Pre-processing for neural networks, Feature Engineering, over fitting and Under fitting, Hyper parameters

**Textbook(s):**

1. Parteek Bhatia, *Machine Learning with Python*, Cambridge University Press, 2023.

**Reference Book(s):**

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, 3rd Edition, O'Reilly Media, 2022.
2. Sebastian Raschka, Vahid Mirjalili, *Python Machine Learning*, Packt Publishing, 3rd edition,

2019.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/106105152; *NPTEL Video Lecture on Introduction to Machine Learning by Prof. Sudeshna Sarkar, Professor of CSE, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24CI504: Artificial Intelligence and Machine Learning** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI504.1** | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO2** | **U24CI504.2** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO3** | **U24CI504.3** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO4** | **U24CI504.4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI504** | | **3** | **2.8** | **2.8** | **2** | **3** | **1.3** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| CO1 | develop source code for data exploration & pre processing using Python libraries | SDG9 | Industry, Innovation and Infrastructure | Predictive models power industrial automation, data-driven decision making, and smart manufacturing, directly enabling innovative industrial solutions |
| CO2 | utilize supervised learning techniques for predictive modelling & performance evaluation | SDG3 | Good Health and Well-being | Involves using sensor data and medical records to predict health outcomes. |
| CO3 | utilize unsupervised learning techniques to analyse unlabelled datasets | SDG11 | Sustainable Cities and Communities | Clustering and anomaly detection support smart city analytics, intelligent traffic management, urban planning, and community monitoring systems |
| CO4 | make use of neural networks, activation functions & optimization strategies to implement CNN | SDG9 | Industry, Innovation and Infrastructure | Neural networks form the core of intelligent automation systems, robotics, and AI-driven solutions that drive technological innovation and infrastructure advancement |

# LINEAR CONTROL SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI505** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply mathematical modelling techniques to derive transfer functions of electrical and mechanical systems using block diagram and signal flow graph methods

**CO2 :** analyze time response characteristics and steady state performance of first and second order control systems

**CO3:** evaluate the stability and frequency response characteristics of control systems using Routh criterion, Root Locus, Bode and Nyquist techniques

**CO4:** analyze control systems using state space techniques and apply suitable compensation methods to improve system performance

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction and Mathematical Modelling:** Introduction to control systems, Classification of control systems, Open loop & closed loop control systems, Effects of feedback, Transfer function concept, Mathematical modelling of physical systems- Translational & rotational mechanical systems, Electrical systems, Force-voltage and force-current analogies; Block diagram representation and reduction techniques, Signal flow graphs, Mason's gain formula.

| **UNIT-II** | **9 Hrs** |
|---|---|

**Time Response Analysis:** Standard test signals, Time response analysis of first order systems, Time response analysis of second order systems, System type and order - Time domain specifications, Steady state response, Steady state errors and error constants

| **UNIT-III** | **9 Hrs** |
|---|---|

**Stability and Frequency Response Analysis:** Concept of stability, Routh-Hurwitz stability criterion, Relative stability, Root locus technique – Construction of root loci, Effect of addition of poles and zeros on root locus; Frequency response analysis – Frequency domain specifications, Correlation between time and frequency domain specifications; Bode plots – Gain margin and phase margin, Stability analysis using Bode plots, Polar plots, Introduction to Nyquist stability criterion

| **UNIT-IV** | **9 Hrs** |
|---|---|

**State Space Analysis and Compensation Techniques:** State variable representation of systems, Conversion of transfer function into state model and vice versa, State modelling of physical systems, State transition matrix, Solution of state equations, Concepts of controllability and observability, Introduction to compensation techniques – Lead compensation, Lag compensation, Lead-lag compensation

**Textbook(s):**


1. I.J. Nagrath & M. Gopal, *Control Systems Engineering*, 7th ed., New Age International Pvt. Ltd., New Delhi, 2021.


**Reference Book(s):**


1. S. Palani, *Control Systems Engineering*, 2nd ed., Tata McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2010.
2. A. Anand Kumar, *Control Systems*, 2nd ed., Prentice Hall of India, New Delhi,2014.
3. A. Nagoorkani, *Control Systems*,2nd ed., New Delhi: RBA Publications.
4. K. Alice Mary, P. Ramana, *Control Systems*, 1st ed., Universities Press, Hyderabad ,2016.


**Web and Video link(s):**

https://onlinecourses.nptel.ac.in/noc22_ee116/preview; *NPTEL Video Lecture on Control Systems by Prof. C.S.Shankar Ram, IIT Madras.*

| **Course Articulation Matrix (CAM):** | | **U24CI505: LINEAR CONTROL SYSTEMS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI505.1** | 3 | 2 | 1 | – | 1 | 2 | 2 | 1 | 1 | – | 2 | 2 | 2 |
| **CO2** | **U24CI505.2** | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | – | 2 | 2 | 2 |
| **CO3** | **U24CI505.3** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | – | 2 | 2 | 2 |
| **CO4** | **U24CI505.4** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |
| **U24CI505** | | **3.0** | **2.75** | **2.00** | **1.25** | **1.25** | **2.25** | **2** | **1** | **1** | **2.0** | **2.0** | **2.0** | **2.0** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply mathematical modelling techniques to derive transfer functions of electrical and mechanical systems using block diagram and signal flow graph methods | **SDG4** | Quality Education | Mathematical modelling, transfer functions, block diagram reduction and signal flow graph analysis strengthen core engineering knowledge and analytical skills essential for quality technical education |
| **CO2** | analyze time response characteristics and steady state performance of first and second order control systems | **SDG9** | Industry, Innovation & Infrastructure | Time response analysis is fundamental for automation and efficient operation of industrial control systems |
| **CO3** | evaluate the stability and frequency response characteristics of control systems using Routh criterion, Root Locus, Bode and Nyquist techniques | **SDG9** | Industry, Innovation & Infrastructure | Stability analysis and frequency response techniques help in designing reliable and robust industrial and communication control systems |
| **CO4** | analyze control systems using state space techniques and apply suitable compensation methods to improve system performance | **SDG12** | Responsible Consumption and Production | State space analysis and compensation techniques improve system efficiency, optimized performance and effective utilization of engineering resources |

# ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V- Semester | **Branch:** Common to all branches | | |
| **Course Code:** | **U24IK506** | **Credits:** | **2** |
| **Hours/Week (L-T-P-E):** | **2-0-0-2** | **CIE:** | **40%** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **60%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga

**CO2:** explain Vedas as principal source of knowledge for scientific inventions

**CO3:** describe different Yog asanas, breathing techniques, chakras, meditation and their benefits

**CO4:** discuss the benefits of yoga as an effective tool for management of human crisis

| **UNIT-I** | **6 Hrs** |
|---|---|

**Basic Structure of Indian Knowledge System:** Introduction, Vedas – origin, classification, structure, Rig Veda, Sama Veda, Yajur Veda, Atharva Veda, UpaVedas – DhanurVeda, SthapatVeda, GandharvaVeda, AyurVeda, Vedanga – Shiksha, Chanda, Vyakarna, Nirukta, Kalpa, Jyothisha, Upanga – Dharmashastra, Mimamsa, Tarkashastra, Purana

| **UNIT-II** | **6 Hrs** |
|---|---|

**Modern Science and Indian Knowledge System:** Introduction, Vedas as basis for modern science, architectural developments, medicine and its relevance, mathematical sciences in Vedas, space and military related developments, chemical sciences

| **UNIT-III** | **6 Hrs** |
|---|---|

**Yoga and Holistic Health Care:** Healthy mind in healthy body, yoga: definition, types, yoga to keep fit: diet, yoga asanas, fundamentals, breathing techniques in Patanjali yoga tradition, pranayama, chakras, meditation, benefits of yoga – physical health, emotional health, prevention of disease, reducing or alleviating symptoms of problems

| **UNIT-IV** | **6 Hrs** |
|---|---|

**Case Studies – Yoga Practice:**

Yoga as an effective tool for management of human crisis – depression, self-concept & mental health, yoga for stress management, yoga: a way to cure for insomnia.

*Requisite: Yoga practice sessions are to be conducted for all students taking this course by the time they complete Unit 1 and Unit 2*

**Textbook(s):**


1. Sathish Chandra Chaterjee, Dhirendramohan Datta, *An Introduction to Indian Philosophy*, New Delhi: Rupa Publications Pvt. Ltd. *(Chapter 2, 3)*
2. RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, New Delhi: Vidyanidhi Prakasham, 2016 *(Chapter 4, 5, 6, 7, 8)*
3. Swami Jitatmananda, *Holistic Science and Vedanta,* Mumbai: Bharatiya Vidya Bhavan *(Chapter 2, 3)*


**Reference Book(s):**


1. Priyadaranjan Ray, S.N. Sen, *The Cultural Heritage of India*, Vol. 6, Science and Technology, Kolkata: The Ramakrishna Mission Institute of Culture.
2. *Yoga Sutra of Patanjali*, Kolkata: Ramakrishna Mission.

**Web and Video link(s):**

5. https://nptel.ac.in/courses/109106059; *NPTEL course on Indian Philosophy by Prof. Satya Sundar Sethy, IIT Madras*
6. https://nptel.ac.in/courses/110101165; *NPTEL course on Yoga and Positive Psychology for Managing Career and Life by Prof. Ashish Pandey, IIT Bombay*

| **Course Articulation Matrix (CAM):** | | **U24IK506B: ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** |
| **CO1** | **U24IK506B.1** | - | - | - | - | - | 1 | - | 2 | 1 | 1 | - | 2 | 1 | 1 |
| **CO2** | **U24IK506B.2** | - | - | - | - | - | 1 | 1 | 2 | 1 | 1 | - | 2 | 1 | 1 |
| **CO3** | **U24IK506B.3** | - | - | - | - | - | 1 | - | 2 | 2 | 1 | - | 2 | 1 | 1 |
| **CO4** | **U24IK506B.4** | - | - | - | - | - | 1 | 1 | 2 | 2 | 1 | - | 2 | 1 | 1 |
| **U24IK506B/ U24IK606B** | | - | - | - | - | - | **1** | **1** | **2** | **1.5** | **1** | **-** | **2** | **1** | **1** |
| | | **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | summarize the basic structure of Vedas, Upavedas, Vedanga, Upanga | **SDG4** | Quality Education | Understanding the foundational structure of Indian knowledge systems supports holistic education, critical thinking, and cultural literacy, contributing to quality and inclusive education. |
| **CO2** | explain Vedas as principal source of knowledge for scientific inventions | **SDG9** | Industry, Innovation and Infrastructure | Recognizing Vedic contributions to science and technology highlights indigenous innovation in areas such as mathematics, architecture and medicine, inspiring modern sustainable technological development. |
| **CO3** | describe different Yog asanas, breathing techniques, chakras, meditation and their benefits | **SDG3** | Good Health and Well-being | Knowledge of yoga, pranayama, and meditation directly promotes physical health, mental well-being, and disease prevention, supporting the SDG goal of ensuring healthy lives for all. |
| **CO4** | discuss the benefits of yoga as an effective tool for management of human crisis | **SDG3** | Good Health and Well-being | Understanding yoga as a therapeutic tool for depression, stress, and insomnia contributes to mental health management and holistic wellness, aligning with SDG3 targets on mental health. |

# TECHNICAL ENGLISH

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V- Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24MH507** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **100** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **-** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

| | |
|---|---|
| **CO1:** | develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation. |
| **CO2:** | enhance communication and professional writing skills through podcast comprehension, group discussions, resume and email writing |
| **CO3:** | develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports. |
| **CO4:** | develop the ability to perform well in interviews and present effectively with clarity of speech and appropriate accent. |

**Activity-1** **2 Hrs**

**Phonetic Foundations, Authentic Audio-Visual Comprehension & Vocabulary Enhancement**: Speech Sounds- Phonemes (Vowels and consonant sounds), word stress, syllables - their role and importance in spoken English

**Authentic Audio-Visual Comprehension**: Movie Clips - Screening of a short native-speaker clip - context comprehension, focus attention on accent features and key expressions

**Vocabulary:** Word Formation- Prefixes-Suffixes

**Activity:** Practice pronunciation through Read-Record-Reflect, analyze audio-visual content for comprehension and expression usage

| | | | |
|---|---|---|---|
| **Activity - 2** | | | **2 Hrs** |

**Story Narration, Writing Skills and Vocabulary Enhancement-** Narrative structure (beginning, build-up, climax, conclusion), Cohesive devices, Voice modulation & Expression. **Writing:** Principles of Paragraph Writing- Importance of Coherence in Writing- Cause and Effect Paragraphs **Vocabulary:** Synonyms and antonyms

**Activity:** Narrate structured stories with peer interaction, Read-Record-Reflect storytelling activity for pronunciation and expression enhancement, Write a coherent cause and effect paragraph, Vocabulary practice exercises on synonyms and antonyms

| | | | |
|---|---|---|---|
| **Activity - 3** | | | **2 Hrs** |

**Reading Comprehension, Vocabulary Enhancement & Elocution Skills- Reading Comprehension:** Main idea identification, interpretation, critical analysis

**Vocabulary Enhancement**: One-word substitutes. **Elocution:** Speech delivery skills (organisation, voice modulation, fluency, pronunciation, and audience engagement)

**Activity:** Read and analyze passages for comprehension and critical interpretation, Read-Record-Reflect activity for improving reading fluency and pronunciation, Vocabulary exercises on one-word substitutes, and deliver a short speech with emphasis on clarity, confidence, and effective expression

**Activity-4** **2 Hrs**

**Think–Pair–Share Conversation (Podcast-Based)**, **Vocabulary Enhancement:** Introduction to authentic spoken English through podcasts, listening for gist and specific information, and note-taking. Think–Pair–Share strategy, use of linking words and expressing agreement/disagreement politely

**Vocabulary Enhancement**: Idioms in context and usage

**Activity**: Listen to podcasts for comprehension and note-making, Think–Pair–Share discussions to exchange ideas and respond confidently, Speak-Record-Reflect activity for improving speaking fluency, pronunciation, and expression

**Activity -5** **2 Hrs**

**Group Discussion, Vocabulary Enhancement**: GD format and roles, rules of participation

**Vocabulary –** Word Pairs, commonly confused words

**Activity:** Engage in group discussions focusing on clear expression and interaction and word pair exercises

**Activity -6** **2 Hrs**

**Reading Comprehension, Visual Interpretation & Vocabulary Enhancement:** Skimming and scanning, identifying main and supporting ideas, distinguishing fact and opinion

**Visual Interpretation:** Interpreting visual cues, logical sequence

**Vocabulary**: Phrasal Verbs: separable and inseparable forms, and contextual usage

**Activity:** Engage in reading comprehension tasks for critical analysis, describe pictures , Seak-Record–Reflect activity for improving fluency, pronunciation, expression, and phrasal verbs practice exercises

**Activity -7** **2 Hrs**

**Motivational Speeches, Presentation Skills & Vocabulary Enhancement**: identifying central theme and tone, note-taking, Narrative techniques

**Presentation** – Speak to Inspire- topic selection, structure (introduction–body–conclusion), **Vocabulary Enhancement** – Collocations- Introduction to collocations, types of collocations, and contextual usage

**Activity**: Listen to motivational speeches for comprehension and analysis, deliver a 3–5-minute inspirational presentation, Speak–Record–Replay activity for improving fluency, pronunciation, and expression, and collocations practice exercises

**Activity -8** **2 Hrs**

**Writing & Vocabulary Enhancement:** Professional Resume Writing techniques, Action verbs in resume writing, Letter of Application, E-mail Etiquette—vocabulary: Jumbled sentences

**Activity**: Prepare a professional resume using an appropriate format and action verbs, write a letter of application and formal e-mail following etiquette and jumbled sentence exercises

**Activity -9** **2 Hrs**

**Reading Comprehension, Newspaper Reading & Vocabulary Enhancement:** Intensive reading , Extensive reading, Newspaper reading:5W1H method, Summarization, vocabulary building

**Activity:** Reading comprehension exercises, Summarizing news content, discussion of current events, Speak–Record–Replay activity for improving fluency, pronunciation and expression. Vocabulary building through contextual usage from news articles

**Activity -10** **2 Hrs**

**PowerPoint Presentations**: Concept and purpose of presentations, layout and structure (title, introduction–body–conclusion), slide design elements, visual aids, common mistakes to avoid

**Activity:** Design and present a poster or PowerPoint presentation on a given topic, Speak–Record-Replay activity for improving fluency, pronunciation and expression, peer interaction and feedback sessions

**Activity-11** **2 Hrs**

**Essay Writing, Vocabulary Enhancement –** Concept and Types of Essays**,** Essay structure (introduction–body–conclusion), paragraph coherence, clarity and objectivity, Sentence completion with correct word/Group alternative word/group

**Activity:** Write essays on given topics focusing on structure, coherence, and clarity. Sentence completion practice exercises

**Activity-12** **2 Hrs**

**Mock Interview – Technical & HR:** Introduction to mock interviews: Purpose and importance, types of interviews, interview etiquette, self-introduction, common HR questions, self-assessment

**Activity:** Mock interview with appropriate dress code. Record and review own performance, Feedback session

**Textbook(s):**


1. Arun Sharma & Meenakshi Upadhyay, *Verbal Ability and Reading Comprehension for CAT & Other Management Examinations*, 8th ed., McGraw Hill Education (India) Private Ltd, 2018.
2. Menakshi Raman & Sangeeth Sharma, *Technical Communication: Principles and Practice,* 3rd ed., New Delhi; New York: Oxford University Press, 2004.


**Reference Book(s):**


1. Nishit K. Sinha, *Verbal Ability and Reading Comprehension for the CAT*, 3rd ed., Pearson India Education Services Pvt. Ltd., Chennai.
2. Harper Collins, *Collins COBUILD English Grammar*, 3rd ed., Harper Collins Publishers Ltd.
3. Jerald J. Alfred, Charles T. Brusaw and Walter E. Oliu, *Handbook for Technical Writing*, 12th ed., Macmillan.
4. R.S. Agarwal, *A modern Approach to Verbal and Non-Verbal Reasoning*, Revised edition 2025, Chand Publishing, India.


**Web and Video link(s):**

1. https://www.youtube.com/watch?v=5SfQhkMsUFk&list=PLA7lNLNvxTzig5dqfGl8DGbLOvUI08yXg&inde x=2; *Learn/Practice English with MOVIES (Lesson #1) Title: The Incredibles*
2. https://www.youtube.com/watch?v=wVhG59zh4uQ&list=PLA7lNLNvxTzig5dqfGl8DGbLOvUI08

yXg&ind ex=4; *Learn English with WRECK-IT RALPH*

3. https://www.youtube.com/watch?v=TkD1QvjKlqU; *The Pursuit of Happiness (2006): Most Powerful Moments!*
4. https://www.youtube.com/watch?v=biCrIlhZrC4; Podcast by Raul John *Inside the Mind of India's AI Kid*-Business Today
5. https://www.youtube.com/watch?v=KwXtalUuhLc; Podcast by Sudha Murthy - *So What If I Lost the Battle, I Lived the War* - The Ranveer Show
6. https://www.youtube.com/watch?v=YyCXp_E4sMU; Motivational Talk by Gour Gopal Das, *SLEEPLESS Nights for Overnight SUCCESS*
7. https://www.youtube.com/watch?v=b-Pn0yXL9y8; Motivational Talk by Admiral McRaven's Speech for Your Day, *5 Minutes to Start Your Day Right! - MORNING MOTIVATION*

| **Course Articulation Matrix (CAM):** | | **U24MH507- Technical English** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24MH507.1** | - | - | - | - | - | - | - | - | 2 | - | 2 | 1 | 1 |
| **CO2** | **U24MH507.2** | - | - | - | - | - | - | - | 2 | 2 | - | 2 | 1 | 1 |
| **CO3** | **U24MH507.3** | - | - | - | - | - | - | - | - | 2 | - | 2 | 1 | 1 |
| **CO4** | **U24MH507.4** | - | - | - | - | - | - | - | 2 | 2 | - | 2 | 1 | 1 |
| **U24MH507** | | | **-** | **-** | **-** | **-** | **-** | **-** | **2** | **2** | **-** | **2** | **1** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | develop effective listening, speaking, reading and writing skills by understanding native-speaker conversations and expressing ideas clearly and confidently using appropriate vocabulary, while maintaining fluency, coherence and accurate pronunciation. | **SDG4** | Quality Education | This aligns with SDG-4 as it develops effective listening, speaking, reading and writing skills that enable learners to understand native-speakers communication and communicate clearly and fluently with appropriate vocabulary and pronunciation to promote quality education |
| **CO2** | enhance communication and professional writing skills through podcast comprehension, group discussions, resume and Quality Education email writing | **SDG4** | Quality Education | This aligns with SDG-4 as it promotes quality education by enhancing employability skills and professional writing skills through podcast comprehension, resume writing, critical reading and group discussion |
| | | **SDG8** | Decent work and Economic growth | This aligns with SDG-8 as it helps students expect productive employment and decent work opportunities by fostering academic and creative thinking |

| | | | | |
|---|---|---|---|---|
| **CO3** | develop the ability to understand reading texts, conversations of both native and non-native speakers, interpret visual information, and produce clear and well-structured technical reports | **SDG4** | Quality Education | This aligns with SDG-4 as it develops the ability to interpret visual information and produce clear and well-structured technical reports for academic and professional contexts |
| **CO4** | develop the ability to present effectively with clarity of speech and appropriate accent | **SDG4** | Quality Education | This aligns with SDG-4 as it enhances effective presentation skills and perform well in interviews |

# MICROCONTROLLERS AND EMBEDDED SYSTEMS LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI508** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** develop the 8086-microprocessor based assembly language programs to solve arithmetic & data processing problems

**CO2:** develop the 8051-microcontroller based assembly language / embedded C programs to solve arithmetic & data processing problems

**CO3:** develop the 8051-microcontroller based assembly language / embedded C programs for interfacing & driving, IO devices

**CO4:** develop the 8051-microcontroller based assembly language / embedded C programs for interfacing & driving, data converters

**LIST OF EXPERIMENTS**

1. The 8086 microprocessor (MP) based ALPs (Assembly language programs) for simple Arithmetic operations (Addition, Subtraction, Multiplication and Division) on Single and Double Precision data
2. The 8086 processor-based ALPs for
   a. Finding Largest / Smallest Number
   b. Arranging in Ascending/ Descending order
3. The 8086 processor-based ALPs for String manipulation
4. The 8051 microcontroller-based ALPs / ECPs (Embedded C Programs) for implementing arithmetic operations (Addition, Subtraction, Multiplication, Division) on single and double precision binary data
5. The 8051-microcontroller based ALP / ECP for searching largest / smallest numbers in an array
6. The 8051-microcontroller based ALP / ECP for arranging numbers in ascending / descending order
7. The 8051-microcontroller based ALP / ECP for matrix keyboard interfacing
8. The 8051-microcontroller based ALP / ECP for 7-Segment display interfacing
9. The 8051-microcontroller based ALP / ECP for LCD interfacing
10. The 8051-microcontroller based ALP / ECP for DAC interfacing
11. The 8051-microcontroller based ALP / ECP for ADC interfacing
12. The 8051-microcontroller based ALP / ECP for stepper / DC motor interfacing

**Laboratory Manual:**

1. Manual for *Microcontrollers and Embedded Systems Laboratory* prepared by faculty of Department of ECIE, KITSW.

**Reference Book(s):**


1. D.V.Hall, *Microprocessors & Interfacing*, 3rd ed., New Delhi: Tata McGraw Hill, 2012.
2. Manish K Patel, *The 8051 Microcontroller Based Embedded Systems*, New Delhi: McGraw Hill

Education (India) Pvt. Ltd., 2014.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc22_ee116; *NPTEL Lecture on Embedded System Design with ARM by By Prof. Indranil Sengupta & Prof. Kamalika Datta, Dept. of EE, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24CI508: MICINTROLLERS AND EMBEDDED SYSTEMS LABORATORY** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI508.1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO2** | **U24CI508.2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO3** | **U24CI508.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO4** | **U24CI508.4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **U24CI508** | | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | develop the 8086-microprocessor based assembly language programs to solve arithmetic & data processing problems | **SDG4** | Quality Education | The content of the course provides foundational technical skills in low-level programming and computer architecture. It contributes to Target 4.4, which aims to increase the number of youth and adults with relevant skills for employment and entrepreneurship by building digital literacy |
| **CO2** | develop the 8051-microcontroller based assembly language / embedded C programs to solve arithmetic & data processing problems | **SDG9** | Industry, Innovation and Infrastructure | Mapping: Microcontrollers like the 8051 are the building blocks of industrial automation, infrastructure monitoring, and electronic innovation.<br>Evidence: The skills developed—such as interfacing with peripheral devices and designing microcontroller-based systems—directly contribute to creating computing technologies and solutions for industry. |
| **CO3** | develop the 8051-microcontroller based assembly language / embedded C programs for interfacing & driving, IO devices | **SDG9** | Industry, Innovation and Infrastructure | Mapping: Foundational to SDG Target 9.5, focusing on enhancing scientific research and upgrading industrial technologies.<br>Justification: Developing microcontroller-based systems is a prerequisite for creating resilient infrastructure and fostering innovation in sectors like automation, telecommunications, and industrial IoT. |
| **CO4** | develop the 8051-microcontroller based assembly language / embedded C programs for interfacing & driving, data converters | **SDG9** | Industry, Innovation and Infrastructure | Data Converters (ADC/DAC): Mastering ADCs and DACs allows for the digitisation of analog world data (temperature, pressure), which is essential for technological progress and industrial innovation in fields like smart manufacturing.<br>This is the core mapping for microcontroller-based engineering courses because it provides the foundational technical capabilities for industrial modernization. |

# ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPLICATIONS LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI509** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** develop source code to load, preprocess, and visualize datasets, and evaluate a baseline classifier by splitting data into training and testing sets using Python libraries

**CO2:** evaluate and compare supervised machine learning algorithms on real-world datasets using appropriate performance metrics

**CO3:** develop source code to solve clustering, dimensionality reduction & image classification problems using unsupervised learning models & deep learning architectures

**CO4:** develop source code for core domain applications by integrating data preprocessing, model training & performance evaluation

## LIST OF EXPERIMENTS

1. Develop a Program to load a dataset using Pandas, display statistics, and plot histograms using Matplotlib
2. Develop a Program to preprocess a dataset: handle missing values, normalize features, encode labels
3. Develop a Program to split a dataset into train/test sets and evaluate a baseline classifier using Scikit-learn
4. Develop a program for implementation of Linear Regression to predict a continuous variable and plot regression line
5. Develop a program for implementation of Logistic Regression for binary classification with performance metrics
6. Develop a Program to build a Decision Tree classifier, visualize the tree, and evaluate accuracy
7. Develop a program to implement KNN classifier and study effect of varying K on accuracy
8. Develop a program to implement K-Means clustering on a dataset and visualize clusters
9. Develop a Program to apply PCA for dimensionality reduction and visualize explained variance
10. Develop a program to build and train a Multi-Layer Perceptron (MLP) for classification using Scikit-learn
11. Develop a Program to implement Random Forest classifier and compare with a single Decision Tree
12. Develop a Program to implement End-to-end ML pipeline – load sensor dataset, preprocess, train a classifier, evaluate and display results

**Textbook(s):**

1. Parteek Bhatia, *Machine Learning with Python*, Cambridge University Press, 2023.

**Reference Book(s):**

1. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*,

O'Reilly Media, 3rd ed., 2022.

2. Sebastian Raschka, Vahid Mirjalili, *Python Machine Learning*, Packt Publishing, 3rd edition, 2019.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/106105152; *NPTEL Video Lecture on Introduction to Machine Learning by Prof. Sudeshna Sarkar, Professor of CSE, IIT Kharagpur.*

**Laboratory Manual (for laboratory component):**

3. Manual for *Artificial Intelligence and Machine Learning Applications Laboratory* prepared by faculty of Department of ECIE, KITSW.

| Course Articulation Matrix (CAM): | | U24CI509: Artificial Intelligence and Machine Learning Applications Laboratory | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI509.1 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO2 | U24CI509.2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO3 | U24CI509.3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO4 | U24CI509.4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI509** | | **3** | **2.8** | **2.8** | **3.0** | **3.0** | **3.0** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply Python libraries (NumPy, Pandas, Matplotlib, Scikit-learn) to load, preprocess, and visualize datasets, and evaluate a baseline classifier by splitting data into training and testing sets. | **SDG 4** | Quality Education | The entire unit is about building foundational digital/computational skills through hands-on programming — the most direct expression of quality technical education |
| **CO2** | evaluate and compare supervised machine learning algorithms — Linear Regression, Logistic Regression, Decision Tree, KNN, SVM, and Naive Bayes — on real-world datasets using appropriate performance metrics. | **SDG9** | Industry, Innovation and Infrastructure | Supervised ML (Regression, SVM, Decision Trees) is the engine of industrial AI — predictive maintenance, quality control, process automation — strongest industry innovation link. |
| **CO3** | design and implement unsupervised learning models (K-Means, PCA) and deep learning architectures (MLP, ANN, CNN) to solve clustering, dimensionality reduction, and image classification problems | **SDG9** | Industry, Innovation and Infrastructure | CNNs, ANNs, and MLP are the core of Industry 4.0. Building these architectures from scratch is the highest-level innovation activity in the course |
| **CO4** | create end-to-end machine learning pipelines for ECI domain applications by integrating data preprocessing, model training, and performance evaluation | **SDG 13** | Climate Action | LSTM forecasting & anomaly detection on sensor, process data maps most directly to environmental monitoring, energy efficiency, and climate impact mitigation |

# SEMINAR

| | | | |
|---|---|---|---|
| **Class:** B. Tech. V – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI510** | **Credits:** | **1** |
| **Hours/Week (L-T-P-E):** | **0-0-2-2** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE:** | **-** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines/ conference proceedings

**CO2:** demonstrate the skills for performing a literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report

**CO3:** create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic

**CO4:** write a "seminar paper" in scientific journal style & format from the prepared seminar report

*Student has to give an independent seminar on the state-of-the-art technical topics relevant to their program of study, which would supplement and complement the program assigned to each student.*

**Guidelines:**

1. The HoD shall constitute a Department Seminar Evaluation Committee (DSEC)
2. DSEC shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format, and (iv)effective seminar presentation
3. There shall be only Continuous Internal Evaluation (CIE) for seminar
4. The CIE for seminar is as follows:

| **Assessment** | **Weightage** |
|---|---|
| Seminar Supervisor Assessment | 20% |
| Seminar Report & Seminar Paper | 30% |
| SDG Alignment | 10% |
| **DSEC Assessment**: Oral presentation with PPT and viva-voce | 40% |
| **Total Weightage:** | **100%** |

**Note:** It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation

(v) **Seminar Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest.

(w) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DSEC.*

(x) **Anti-Plagiarism Check:** The seminar report should clear the plagiarism check as per the Anti-Plagiarism (including AI Plagiarism) policy of the institute.

(y) **Presentation:** Each student should prepare a PPT with informative slides and make an effective oral presentation before the *DSEC* as per the schedule notified by the department.

(z) The student has to register for the Seminar as a supplementary examination in the following cases:

vii) The student is absent for oral presentation and viva-voce

viii) The student fails to submit the report in prescribed format

ix) The student fails to fulfill the requirements of seminar evaluation as per specified guidelines.

x) The CoE shall send a list of students registered for supplementary to the HoD concerned

xi) The DSEC, duly constituted by the HoD, shall conduct seminar evaluation and send the award list to the CoE within the stipulated time

| Course Articulation Matrix (CAM): | | U24CI510: SEMINAR | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI510.1 | 2 | 2 | - | 2 | 2 | 1 | 1 | - | 1 | - | 3 | 1 | 1 |
| CO2 | U24CI510.2 | 2 | 3 | 1 | 3 | 2 | 1 | 1 | 1 | 2 | - | 3 | 1 | 1 |
| CO3 | U24CI510.3 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 1 |
| CO4 | U24CI510.4 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | - | 2 | 1 | 1 |
| U24CI510 | | **1.5** | **2** | **1** | **2** | **2** | **1.25** | **1.25** | **1.33** | **2.33** | **1** | **2.5** | **1** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | select current topics in their engineering discipline & allied areas from peer reviewed journals / technical magazines / conference proceedings | **SDG 4** | Quality Education | Identifying and studying emerging ECE technologies such as 6G communications, VLSI, IoT, Artificial Intelligence, Embedded Systems, and Signal Processing promotes self-directed learning, technical competency, and continuous knowledge acquisition. |
| **CO2** | demonstrate the skills for performing literature survey, identify gaps, analyze the technical content and prepare a well-documented seminar report | **SDG 9** | Industry, Innovation and Infrastructure | Literature review and technical analysis of advanced communication systems, semiconductor technologies, smart electronics, and intelligent networks foster innovation, research culture, and technological infrastructure development. |
| **CO3** | create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject & sensitivity towards social impact of the seminar topic | **SDG 11** | Sustainable Cities and Communities | Seminar presentations on smart cities, intelligent transportation systems, IoT-enabled urban services, disaster management systems, and smart communication networks highlight the role of ECE technologies in building sustainable and connected communities. |
| **CO4** | write a "seminar paper" in scientific journal style & format from the prepared seminar report | **SDG 12** | Responsible Consumption and Production | Preparation of technical papers promotes ethical dissemination of research findings, proper citation practices, responsible use of information resources, and documentation of sustainable engineering solutions. |

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
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# Semester -VI Syllabi

**URR24 VI SEMESTER**

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | OE | U24OE601Y | Open Elective – Management Basket (OE-MB) | 2 | 1 | - | 3 | 3 |
| 2 | PEC | U24CI602X | Program Elective –I /MOOCs-I | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI603 | Embedded Systems with ARM Processor | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI604 | Analog and Digital Communications | 2 | 1 | - | 3 | 3 |
| 5 | PCC | U24CI605 | System Verilog for Verification | 2 | 1 | - | 3 | 3 |
| 6 | IKSC | U24IK606B | Universal Human Values - II | 2 | - | - | 2 | 2 |
| 7 | PCC | U24CI607 | Internet of Things Lab | - | - | 2 | 2 | 1 |
| 8 | PCC | U24CI608 | Analog and Digital Communications Lab | - | - | 2 | 2 | 1 |
| 9 | PCC | U24CI609 | Embedded Systems with ARM Processor Lab | - | - | 2 | 2 | 1 |
| 10 | ELC | U24CI610 | Mini Project | - | - | 2 | 2 | 1 |
| **Total:** | | | | **12** | **5** | **8** | **25** | **21** |
| Additional Learning[@]: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 5 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 26 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

[@] *List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula*

***B. Tech Honours with Research****: Students opting for B. Tech Honours with Research, shall undergo a 2-Month Mandatory Research Internship-II (5 Credits) at respective department during the summer vacation after VI Semester.*

| **Open Elective – Management Basket (OE-MB)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24OE601A | Management Economics and Accountancy |
| 2. | U24OE601B | Engineering Finance |
| 3. | U24OE601C | Organizational Behaviour |
| 4. | U24OE601D | E-Commerce and Digital Marketing |
| 5. | U24OE601E | *Any other course approved by BoS Chair and Dean AA* |
| **Program Elective – I Basket / MOOCs-I** | | |
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI602A | Introduction to Operating Systems |
| 2. | U24CI602B | Cloud Computing |
| 3. | U24CI602C | Introduction to FPGA design |
| 4. | U24CI602D | Advanced Signal Processing |
| 5. | U24CI602E | *Any other course approved by BoS Chair and Dean AA* |

# MANAGEMENT ECONOMICS AND ACCOUNTANCY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE601A** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** comprehend the basic concepts of management, functions of management

**CO2:** distinguish between micro & macroeconomics & forms of business organizations

**CO3:** identify pass journal entries & post them into ledgers and make use of profit & loss accounts to assess the financial position through the balance sheet

**CO4:** evaluate financial statements with the help of various ratios & reveal the financial health of the organization

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Management:** Concept of Management, Features of Management, Importance of Management, Nature and Scope of Management, Fayol's Administrative Management, Taylor's Scientific Management

**Functions of Management: Planning-** Concept of Planning, Nature of Planning, Importance of Planning, Planning Process, Types of Planning; **Organizing**-Concept of Organizing, Organization Structure- line and staff, Advantages of Organizing; **Staffing** - Meaning, Functions of Human Resources Management; **Directing**- Elements of Directing- Supervision; Leadership- Nature; Motivation - Nature, Types; Communication- Process, Types, Barriers to effective communication; **Co-ordination**- Definition, Steps to achieve effective coordination; **Controlling**- Definition, Process

| **UNIT-II** | **9 Hrs** |
|---|---|

**Economics:** Meaning and definition, Scope, Micro and Macro Economics, Methods of Economics

**Forms of Business Organization:** Sole Proprietor ship, Partnership firm - Types of Partners, Limited Liability Partnership (LLP), Joint Stock Company - Features, Types, Merits and demerits, Cooperative society

| **UNIT-III** | **9 Hrs** |
|---|---|

**Introduction to Financial Accounting:** Accounting concepts and conventions, Double Entry System and Book Keeping, Overview of accounting cycle, Journal-meaning, Journalizing, Ledger - Meaning, Ledger posting, Balancing; Cash book (Single column), Preparation of Trial balance

**Final Accounts:** Trading Account, profit and loss account and Balance Sheet with simple adjustments

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Financial Statement Analysis:** Introduction to Financial Statement Analysis**,** Ratio Analysis, Introduction, Types of Ratios, Analysis and Interpretation of Liquidity Ratios, Profitability ratios, Activity Ratios, and Capital structure Ratios (simple problems)

**Textbook(s):**


1. L.M.Prasad, *Principles and Practices of Management,* Sultan Chand & Sons Educational Publishers, 11th ed. 2025, New Delhi. (*Part –I to Part-VI*)
2. D. N. Dwivedi, *Engineering Economics*: *Text & Cases*, Vikas Publishing, 5th ed., 2014. (*Chapter-3*)
3. R. Narayana Swamy, *Financial Accounting – A Managerial Perspective*, Prentice Hall of India, 7th ed., 2023, New Delhi. (*Chapter VI*)


**Reference Book(s):**


1. Harold Koontz and Heinz Weihrich, *Essentials of Management*, 6th ed., New Delhi: Tata

McGraw Hill Publications, 2015.
2. Maheshwari, S. N., & Maheshwari, S. K. (2024). *Financial Accounting*, 7th ed., Vikas Publishing House Pvt. Ltd, 2024.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg52
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ec10

**Course Articulation Matrix (CAM): U24OE601A - MANAGEMENT ECONOMICS AND ACCOUNTANCY**

| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **U24OE601A.1** | - | 3 | 3 | 2 | - | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 1 |
| **CO2** | **U24OE601A.2** | - | 2 | 2 | - | - | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 |
| **CO3** | **U24OE601A.3** | - | 1 | 2 | 1 | - | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 1 |
| **CO4** | **U24OE601A.4** | - | 2 | 2 | 2 | - | 1 | 2 | - | 3 | 2 | 3 | 2 | 1 |
| **U24OE601A** | | **-** | **2** | **2.25** | **1.67** | **-** | **1.75** | **2.5** | **2.67** | **3** | **2.75** | **3** | **2** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

**CO–SDG Alignment Matrix**

| CO | CO Statement<br>*The student should be able to…* | Relevant SDG | SDG Description | Mapping Justification |
|---|---|---|---|---|
| **CO1** | comprehend the basic concepts of management | **SDG 4** | Quality Education | Understanding the management concepts and managerial function will help the students to take effective and efficient decisions and able to solve work place problems. |
| **CO2** | distinguish between micro & macro- economics & forms of business organizations | **SDG 8** | Decent Work and Economic Growth | Economics concepts will help to promote sustained, inclusive and sustainable economic growth, and different forms of organizations will provide knowledge about creating full and productive employment and decent work for all |
| **CO3** | identify pass journal entries & post them into ledgers and make use of profit & loss accounts to assess the financial position through the balance sheet | **SDG 17** | Partnerships for the goals | accounting concepts and conventions will promote a universal, rules-based, open, non-discriminatory and equitable application of |
| **CO4** | evaluate financial statements with the help of various ratios & reveal the financial health of the organization | **SDG 8** | Decent Work and Economic Growth. | Evaluating financial statements through ratio analysis reveals the financial health of an organization, enabling better decision-making, efficient resource utilization, and sustainable growth. |

# ENGINEERING FINANCE

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE601B** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept.

**CO2 :** apply capital budgeting techniques including inflation adjusted Net Present Value/Internal Rate Return for project evaluation and selection.

**CO3:** analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects.

**CO4:** evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets.

| **UNIT-I** | **10 Hrs** |
|---|---|

**Fundamentals of Engineering Finance:** Engineering Finance – Meaning, Definition, and Scope; Role of Finance in Engineering – Importance for engineers in decision making and cost control; Ethics in Engineering Finance – Transparency, Cost estimation honesty, Avoidance of financial conflicts of interest; Financial Management– Meaning, Functions, Objectives (Profit maximization vs Wealth maximization), Sources of Finance, Time value of Money

| **UNIT-II** | **9 Hrs** |
|---|---|

**Investment Decisions:** Investment Decisions- Types of Investment projects, Investment evaluation criteria; Methods of capital budgeting– Discounted cash flow techniques vs Non discounted cash flow techniques, Inflation adjusted NPV and IRR, Comparison and selection of mutually exclusive engineering projects

| **UNIT-III** | **10 Hrs** |
|---|---|

**Cost-Volume-Profit Analysis:** Cost concepts- Fixed, Variable, Marginal, Sunk, Opportunity costs, Direct and Indirect costs; Breakeven analysis– Meaning, Assumptions, Graphical and Mathematical determination of breakeven point, Make or buy decisions using breakeven analysis, Application of breakeven analysis in engineering projects

| **UNIT-IV** | **10 Hrs** |
|---|---|

**Replacement Decisions and Valuation of engineering assets:** Replacement analysis– Meaning, Need, Defender vs Challenger concept, Service life; Valuation of equipment's and physical assets- Depreciation definition, Depreciation fund; Methods of depreciation- Straight line, Declining balance, Sum of the years-digits, Sinking fund and Service output method, Application of depreciation methods on equipment's and physical asset with the passage of time

**Textbook(s):**


1. M Y Khan and P K Jain, *Financial Management,* Tata McGraw Hill 5th ed., ISBN:978-0-07-065614-7. *(Unit-I in part 1 of section 1,2&3 and Unit-II in part 3 of 9&10)*
2. R. Panneerselvam, *Engineering Economics,* PHI Learning 2nd ed., ISBN:978-81-203-4837-0. *(Unit-III in Chapter 1&16 and Unit-IV in Chapter 8& 9)*


**Reference Book(s):**


1. F.K. Crundwell, *Finance for Engineers: Evaluation and Funding of Capital Projects*, Springer London Ltd, Atlantic Publishers and Distributors Pvt. Ltd., ISBN: 978-1849967082, 2010.
2. Robert L. Kosowski, Salih N. Neftci, *Principles of financial engineering*, Academic press,

Atlantic Publishers and Distributors Pvt. Ltd., 3rd ed., ISBN: 978-0123869685, 2014.
3. D. N. Dwivedi, *Engineering Economics: Text & Cases*, Vikas Publishing, 5th ed., ISBN: 9788126510887, 2014.
4. Prasanna Chandhra, *Financial Management: Theory and Practice,* Tata Mc Graw Hill Education (India) Pvt. limited, ISBN-10: 93-392-1225-8, 2015.
5. Chan S. Park, *Fundamentals of Engineering Economics*, Pearson Education, 3rd ed., ISBN: 978-9352864379, 2017.
6. Chatterjee Partha Sheikh Salim, *Engineering Economy & Financial Management*, Himalaya Publishing House, ISBN:978-9350247389, 2011.

**Course Articulation Matrix (CAM): U24OE601B - ENGINEERING FINANCE**

| CO | | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **U24OE601B.1** | 2 | - | - | - | - | - | 2 | - | - | 2 | 2 | 2 | 1 |
| **CO2** | **U24OE601B.2** | - | 3 | - | - | 2 | - | - | - | - | - | 3 | 2 | 1 |
| **CO3** | **U24OE601B.3** | - | - | 2 | - | - | - | - | 2 | - | 2 | - | 2 | 1 |
| **CO4** | **U24OE601B.4** | - | - | 2 | 2 | | 2 | - | - | - | 2 | 2 | 2 | 1 |
| | **U24OE601B** | **2** | **3** | **2** | **2** | **2** | **2** | **-** | **2** | **-** | **2** | **2.3** | **2** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 – LOW** | | | | | | | | | | | | | | |

**CO–SDG Alignment Matrix**

| CO | CO Statement *The student should be able to…* | Relevant SDG | SDG Description | Mapping Justification |
|---|---|---|---|---|
| **CO1** | Explain fundamentals of engineering finance, financial management objectives, ethics, and time value of money concept. | **SDG 4** | Quality Education | Promotes financial literacy, ethical decision-making, and professional responsibility essential for quality education and transparent institutional practices. |
| | | **SDG 16** | Peace, Justice and Strong Institutions | |
| **CO2** | Apply capital budgeting techniques including inflation adjusted NPV/IRR for project evaluation and selection. | **SDG 8** | Decent Work and Economic Growth | Supports economically viable investment decisions, efficient resource allocation, industrial growth, and sustainable infrastructure development. |
| | | **SDG 9** | Industry, Innovation and Infrastructure | |
| **CO3** | Analyse various cost concepts and determine breakeven point for make or buy decisions in engineering projects. | **SDG 9** | Industry, Innovation and Infrastructure | Encourages cost efficiency, optimized production planning, and responsible utilization of resources in engineering and industrial projects |
| | | **SDG 12** | Responsible Consumption and Production | |
| **CO4** | Evaluate asset replacement decisions and apply depreciation methods to determine the economic life and value of engineering assets. | **SDG 8** | Decent Work and Economic Growth | Promotes sustainable asset management, economic efficiency, lifecycle optimization, and responsible use of engineering resources. |
| | | **SDG 12** | Responsible Consumption and Production | |

# ORGANIZATIONAL BEHAVIOUR

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | Branch: Common to all branches | |
| **Course Code:** | **U24OE601C** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **40%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **60%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** evaluate the fundamentals, importance, influencing factors & communication processes of Organizational Behaviour

**CO2:** analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress & motivation

**CO3:** examine group behaviour, team effectiveness, conflict management, leadership, power, politics & group dynamics in organizational settings

**CO4:** evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life & international organizational behaviour

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** Foundations of organizational behavior, Concept, Importance, Factors influencing organizational behavior, Challenges and opportunities for organization behavior, Managerial perspective of OB; Communication- Process, Channels, Communication barriers, Measures to overcome barriers

| **UNIT-II** | **9 Hrs** |
|---|---|

**Individual Behavior:** Individual in the organization, Nature of man, Models of man, Personality-Stages of development of personality; Perception-Factors influencing perception; Learning-Theories of Learning-Cognitive Learning Theory, Behaviourist Learning Theory; Attitudes-Formation of attitudes; Personality and emotions, Managing emotions and stress in organizations; Motivation- Motivation theories-Maslow's Needs Hierarchy Theory and Herzberg's Two-Factor Theory

| **UNIT-III** | **9 Hrs** |
|---|---|

**Group decision making:** Groups in organization, Basic group concepts, Groups vs Teams, Understanding work teams-Types of teams, Creating effective teams; Conflicts-Types of conflicts, Strategies for resolution of conflicts in groups

**Group dynamics:** Group dynamics, Leadership-Leadership types and managerial effectiveness, Trust and leadership, Power and politics, Basis of power, Organizational politics

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Organization structure:** Organization structure, Size and design; Organizational culture; Organizational change-Resistance to change; Organizational stress- Factors contribute to stress, Coping strategies, Stress and performance; Organizational effectiveness-concepts; Quality of work life-concepts, International organizational behavior concepts

**Textbook(s):**


1. Stephen P. Robbins, Timothy A. Judge & Neharika Vohra, *Organizational Behavior,* Pearson India, 18th ed., 2022, New Delhi. (*Chapters I to IV*)
2. K. Aswathappa, *Organizational Behaviour,* Himalaya Publishing House, 14th ed., 2021, Mumbai. (*Chapters I to IV*)


**Reference Book(s):**


1. Fred Luthans, *Organizational Behavior,* McGraw Hill Education, 13th ed., 2020, New York.
2. Uma Sekaran, *Organizational Behavior: Text and Cases,* McGraw Hill Education, 2nd ed.,

2019, New Delhi.

3. S. S. Khanka, *Organizational Behavior,* S. Chand Publishing, 11th ed., 2021, New Delhi.

**Web and Video link(s):**

1. *Harvard Business Review – Organizational Behavior Articles and Videos*
2. *Web resources and expert videos on leadership, teamwork, communication, conflict management, and organizational effectiveness.*

| Course Articulation Matrix (CAM): | | U24OE601C- ORGANIZATIONAL BEHAVIOUR | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24OE601C.1 | 2 | - | - | - | - | - | - | 2 | 2 | - | - | 2 | 1 |
| CO2 | U24OE601C.2 | - | 3 | - | - | - | - | 2 | -- | - | - | 3 | 2 | 1 |
| CO3 | U24OE601C.3 | - | 2 | - | - | - | - | - | 2 | 2 | 2 | - | 2 | 1 |
| CO4 | U24OE601C.4 | - | - | 2 | - | - | 2 | - | - | - | 2 | 2 | 2 | 1 |
| | | **2** | **2.5** | **2** | **-** | **-** | **2** | **2** | **2** | **2** | **2** | **2.5** | **2** | 1 |
| **3 – HIGH, 2 – MEDIUM, 1 – LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | Explain the fundamentals, importance, influencing factors, and communication processes of Organizational Behaviour | **SDG 4** | Quality Education | Understanding organizational behaviour and communication processes helps students develop professional knowledge, communication, and workplace learning skills. |
| **CO2** | Analyse individual behaviour including personality, perception, learning, attitudes, emotions, stress, and motivation | **SDG 3** | Good Health and Well-being | Analysing emotions, stress, motivation, and attitudes promotes mental well-being, self-management, and healthy work practices. |
| **CO3** | Examine group behaviour, team effectiveness, conflict management, leadership, power, politics, and group dynamics in organizational settings | **SDG 16** | Peace, Justice and Strong Institutions | Studying leadership, conflict management, teamwork, and group dynamics supports inclusive, cooperative, and effective organizational practices |
| **CO4** | Evaluate organizational structure, culture, innovation, change, organizational effectiveness, quality of work life, and international organizational behaviour | **SDG 8** | Decent Work and Economic Growth | Evaluating organizational culture, innovation, quality of work life, and change management supports productive employment and sustainable organizational growth. |

# E-COMMERCE & DIGITAL MARKETING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24OE601D** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** interpret the concepts, scope, types, functions, framework, opportunities, & limitations of E-Commerce and analyse its role in modern business & electronic transactions

**CO2:** analyze e-payment systems, e-finance operations, e-banking, e-trading, legal framework, governing e-commerce transactions

**CO3:** evaluate digital marketing practices, emerging trends & consumer behaviour in the online environment

**CO4:** determine digital marketing channels and develop effective online marketing plans

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to E-Commerce:** E-Commerce – Introduction, Definition, Scope, Evolution, Internet commerce vs E-commerce; Electronic commerce market, E-commerce industry Framework, Trade cycle in E-commerce, Electronic Data Interchange (EDI), E-commerce functions; Types of E-commerce – B2B, B2C, C2C, C2B, B2G, G2B, and G2C; Forces fuelling E-commerce – Differences between traditional commerce and E-commerce, Limitations of E-commerce, Introduction to Artificial Intelligence (AI) in E-commerce

| **UNIT-II** | **9 Hrs** |
|---|---|

**E-payment Systems:** Digital payment requirements; Types of E-Payment systems - Digital token-based E-payment systems, Credit card as E-payment system, Mobile payments, Smart card cash payment system, Micropayment system, E-Security, E-Cash; E-Finance- Areas of financing; E-Banking - Traditional banking vs E-banking, Operations in E-banking; E-Trading – Stock market trading, Importance and advantages of E-trading

**Legal Framework for E-Commerce:** E-Commerce legal framework - The Information Technology Act 2000, Information Technology (Amendment) Act-2008, Copyrights, Defamation, Privacy, Contracts, Taxation, Signing a contract electronically, Domain name and registration

| **UNIT-III** | **9 Hrs** |
|---|---|

**Digital Marketing:** Concept, Components of Digital marketing, Need and scope of Digital marketing, Benefits of Digital marketing, Digital marketing platforms and strategies, Comparison of marketing and Digital marketing, Digital marketing trends, Marketing in the digital era; Segmentation – Importance of audience segmentation, Different segments used in digital media, Organizational characteristics, Purchasing characteristics, Using Digital media to reach, Acquisition and retention of new customers, Digital media for customer loyalty

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Channels of Digital Marketing:** Digital marketing, Website marketing, Search engine marketing, Search engine optimization, Online advertising, Email marketing- Campaign design, Automation, Personalization; Blog marketing-Content creation, Blogging platforms, Social media marketing-Marketing through Facebook, Instagram, LinkedIn, X (Twitter) and YouTube, Audio, Video and interactive marketing, Mobile marketing, Digital Marketing Plan-Need for Digital marketing plan, Elements of Digital marketing plan, Writing the marketing plan and implementation

**Textbook(s):**

1. C. S. V. Murthy, *E-Commerce: Concepts, Models & Strategies*, Himalaya Publishing House, 2nd ed., 2025.

2. Seema Gupta – *Digital Marketing*, McGraw-Hill, 3rd ed., 2023.
3. Tracy L. Tuten & Michael R. Solomon – *Social Media Marketing*, SAGE Publication, 5th ed., 2023.

**Reference Book(s):**

1. Matthew Reynolds, *Beginning E-Commerce with Visual Basic, ASP, SQL Server 7.0 & MTS*, Wrox Publisher.
2. P. T. Joseph, S.J., *E-Commerce: An Indian Perspective,* PHI Learning Pvt. Ltd., 7th ed., 2023.
3. Michael Miller, *B2B Digital Marketing: Using the Web to Market Directly to Businesses,* Pearson India, 1st ed., (2012), Indian reprint 2015.

**Web and Video link(s):**

1. https://youtu.be/qnBhOVH1QQ8?si=6UtzpR5d6t8Rk5da; *Digital Marketing Full Course 2026 In 24 Hrs | Digital Marketing Tutorial for Beginners*
2. https://youtu.be/qsO_YCjgBFI?si=zVdKwrU8l6eEr4wg; *Digital Marketing Tutorial for Beginners*

| **Course Articulation Matrix (CAM):** | | **U24OE601D: E-COMMERCE & DIGITAL MARKETING** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24OE601D.1** | 2 | 2 | 1 | - | 2 | 1 | - | - | 1 | - | 2 | 2 | 1 |
| **CO2** | **U24OE601D.2** | 2 | 2 | 1 | 1 | 2 | 2 | 1 | - | 1 | 1 | 1 | 2 | 1 |
| **CO3** | **U24OE601D.3** | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 1 |
| **CO4** | **U24OE601D.4** | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 1 |
| **U24OE601D** | | **2** | **2** | **1.5** | **1.3** | **2** | **1.25** | **1** | **1.5** | **1.5** | **1.3** | **1.75** | **2** | 1 |
| **3 – HIGH, 2 – MEDIUM, 1 – LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | interpret the concepts, scope, types, functions, framework, opportunities, & limitations of E-Commerce and analyse its role in modern business & electronic transactions | **SDG 8** | Decent Work and Economic Growth | E-Commerce promotes entrepreneurship, digital business growth, employment opportunities, and innovation in the global economy |
| **CO2** | analyze e-payment systems, e-finance operations, e-banking, e-trading, legal framework, governing e-commerce transactions | **SDG 9** | Industry, Innovation and Infrastructure | Digital payment systems and e-banking strengthen technological infrastructure, financial inclusion, and innovation in digital industries. |
| **CO3** | evaluate digital marketing practices, emerging trends & consumer behaviour in the online environment | **SDG 12** | Responsible Consumption and Production | Digital marketing helps organizations understand consumer behaviour and promote sustainable and responsible consumption patterns. |
| **CO4** | determine digital marketing channels and develop effective online marketing plans | **SDG 17** | Partnerships for the Goals | Digital marketing channels improve global communication, collaboration, networking, and partnerships among businesses and stakeholders |

# INTRODUCTION TO OPERATING SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI602A** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** identify functional constituents of operating systems and choose effective process scheduling algorithms

**CO2:** analyze issues related to process synchronization & offer operative solutions

**CO3:** make use of memory & storage management methods for effective implementation of an operating system

**CO4:** utilize file allocation & IO subsystem management methods in an operating system

| **UNIT-I** | **9 Hrs** |
|---|---|

**Basics of operating systems:** Generations, Types, Structure, Services, System Calls, System Boot, System Programs, Protection and Security

**Process management:** Process Concepts, Process States, Process Control Block, Scheduling-Criteria, Scheduling algorithms and their evaluation, Threads, Threading issues

| **UNIT-II** | **9 Hrs** |
|---|---|

**Process synchronization:** Background, Critical-Section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors

**Deadlock:** System Model, Deadlock characterization, Deadlock prevention, Detection and avoidance, Recovery form deadlock

| **UNIT-III** | **9 Hrs** |
|---|---|

**Memory management:** Main memory, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation, Virtual memory, Demand paging, Page replacement algorithms, Allocation of frames, Thrashing

**Storage management:** Mass-storage structure, Disk structure, Disk attachment, Disk scheduling, RAID structure

| **UNIT-IV** | **9 Hrs** |
|---|---|

**File system interface:** File concept, Access methods, Directory structure, File system structure, Allocation methods, and Free-space management

**IO Subsystems:** I/O hardware, I/O interface, Kernel I/O subsystem, I/O streams

**Domain Structure and Access matrix Case study** – Windows OS Case study- Linux / Unix Sample programming concepts in Linux / Unix (shell scripting)

**Textbook(s):**


1. Abraham Silberschatz, Peter B Galvin, Gerg Gagne, *Operating System Concepts*, Global edition, 10th ed. Wiley, Hoboken, NJ, USA, 2018 *(Chapters 1 to 11, 13 to 14 ,17 ,19)*
2. D.M. Dhamdhare, *Operating Systems: A Concept Based Approach*, 3rd ed. Tata McGraw-Hill, New Delhi, 2012 *(Chapters 1 to 14)*


**Reference Book(s):**


1. William Stalling, *Operating Systems: Internals and Design Principles*, 7th ed. Pearson Education, Inc., NJ, USA 2012
2. Andrew S Tanenbaum, Herbert Bos, *Modern Operating Systems*, 5th ed. Pearson Publication, New Jersey, USA, 2017.
3. Charles Crowley, *Operating System: A Design-oriented Approach*, Mc-Graw Hill, New Delhi, 2000.

4. Maurice Bach, *Design of the Unix Operating Systems*, 8th ed. Prentice-Hall of India, New Delhi, 2020.
5. Daniel P. Bovet, Marco Cesati, *Understanding the Linux Kernel*, 3rd ed., O'Reilly and Associates, USA, 2018.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc24_cs108/preview, *NPTEL Video Lecture on Operating System Fundamentals by Prof. Santanu Chattopadhyay, IIT Kharagpur.*
2. https://onlinecourses.nptel.ac.in/noc23_cs101/preview, NPTEL *Video Lecture on Introduction to Operating Systems by Prof. Chester Rebeiro IIT Madaras.*

| Course Articulation Matrix (CAM): | | U24CI602A: INTRODUCTION TO OPERATING SYSTEMS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI602A.1 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO2 | U24CI602A.2 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO3 | U24CI602A.3 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| CO4 | U24CI602A.4 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 |
| **U24CI602A** | | **3** | **2** | **3** | **1** | **1** | **2** | **3** | **2** | **2** | **1** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify functional constituents of operating systems and choose effective process scheduling algorithms | **SDG9** | Industry, Innovation and Infrastructure | Understanding OS structure, types (e.g., distributed, real-time), and services is fundamental to building the global Information and Communication Technology (ICT) infrastructure required for sustainable industrialisation. Process Management & Scheduling: Advanced scheduling algorithms (SJF, Round Robin) and evaluation criteria (throughput, CPU utilization) are core to optimizing resource-use efficiency. Efficient process management ensures that industrial and commercial systems run with minimal energy waste and maximum productivity. |
| **CO2** | analyze issues related to process synchronization & offer operative solutions | **SDG9** | Industry, Innovation and Infrastructure | Infrastructure Reliability: Process synchronization (background, critical-section problem, and solutions like semaphores and monitors) ensures data consistency and system stability in complex infrastructures.<br>System Resilience: Deadlock prevention, detection, and avoidance are critical for ensuring that industrial-scale computing systems do not fail or "freeze" under heavy loads, supporting the development of resilient digital infrastructure. |
| **CO3** | make use of memory & storage management methods for effective implementation of an operating system | **SDG9** | Industry, Innovation and Infrastructure | Memory Management (Virtual Memory, Paging, Segmentation): These concepts represent the fundamental innovations that allow modern computing infrastructure to function efficiently. |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| | | | | They enable complex industrial systems and software to run on limited physical hardware.<br>Storage Management (RAID, Disk Scheduling, Mass-Storage): These topics focus on the resilient infrastructure required for data integrity and high-performance computing, which are critical for sustainable industrialization and technological development. |
| **CO4** | utilize file allocation & IO subsystem management methods in an operating system | **SDG9** | Industry, Innovation and Infrastructure | These topics cover the fundamental infrastructure of computing. Efficient allocation methods and free-space management are critical for building resilient, high-performance data infrastructures. I/O hardware and interfaces are the building blocks of technological innovation, enabling the connectivity required for smart cities and advanced industrial automation |

# CLOUD COMPUTING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI602B** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

- **CO1:** identify the fundamental concepts of cloud computing including service & deployment models
- **CO2:** make use of virtualization & containerization for cloud computing applications
- **CO3:** apply cloud-native principles including containerization with Docker, orchestration with Kubernetes & CI/CD pipelines for modern application delivery
- **CO4:** develop cloud-based applications using AWS & identify emerging cloud paradigms

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Cloud Computing:** Basic concepts and terminology, Goals and benefits, Risks and challenges, Characteristics of cloud computing, NIST Cloud Computing Reference Architecture, Cloud Characteristics

**Cloud Delivery Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Cloud delivery sub models, Use cases of cloud delivery models

**Cloud Deployment Models:** Public, private, hybrid and multi-cloud deployments; Architectural considerations for the cloud environment

| **UNIT-II** | **9 Hrs** |
|---|---|

**Cloud-Enabling Technologies:** Networks and internet architecture, Cloud data center technology, Modern virtualization, QEMU, Multitenant technology, Service technology and service APIs

**Containerization:** Containers vs virtual machines, Container hosting, Container package management, Container orchestration, Container network, Container Images, Container build files, Multi container types

**Common Container Technologies:** Docker container engine architecture, Kubernetes container orchestrator architecture

| **UNIT-III** | **9 Hrs** |
|---|---|

**Cloud Infrastructure Mechanisms:** Logical network perimeter, Virtual server, Hypervisor, Cloud storage device, Cloud usage monitor, Load balancers, Resource cluster, Resource replication

**Working with Clouds:** Prominent Cloud Service Providers (AWS, GCP & Microsoft Azure); DevOps and CI/CD in cloud

**Cloud Security and Cybersecurity Mechanisms:** Basic security terminology, Basic threat terminology, Threat agents, Common threats, Access-oriented mechanisms, Data-oriented mechanisms

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Cloud Applications:** Cloud-based task alert application, Cloud-based health-monitoring application

**Cloud application development:** AWS EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application & transport layer protocols in EC2, launching an EC2 Linux instance, S3 buckets and SQS service

**Emerging Clouds:** ML in clouds, Quantum computing in clouds, Vehicular clouds

**Textbook(s):**

1. Thomas Erl, Eric Barceló Monroy, *Cloud Computing: Concepts, Technology, Security & Architecture*, Pearson Education, NJ, 2nd ed. 2024. *Chapters (3-8,10-11)*

2. Dan C. Marinescu, *Cloud Computing Theory and Practice,* Morgan Kaufmann, MA, 3rd ed. 2023 *Chapters (13, Appendix-A, Appendix-B)*

**Reference Book(s):**

1. Daniel Kirsch and Judith Hurwitz, *Cloud Computing for Dummies,* John Wiley & Sons, NJ, 2nd ed., 2020.
2. Michael J. Kavis, *Architecting the Cloud*, Wiley, NJ, 2014.
3. Kris Nova, Justin Garrison, *Cloud Native Infrastructure*, O'Reilly Media, CA, 2017.
4. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *Mastering Cloud Computing*, McGraw-Hill Education, India, 1st ed., 2013.
5. Arshdeep Bahga, Vijay Madisetti, *Cloud Computing: A Hands-On Approach*, Universities Press, India, 1st ed., 2014.

**Web and Video link(s):**

https://nptel.ac.in/courses/106105167; *NPTEL Video Lectures on Cloud Computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI602B: CLOUD COMPUTING | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI602B.1 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO2 | U24CI602B.2 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO3 | U24CI602B.3 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO4 | U24CI602B.4 | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| U24CI602B | | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify the fundamental concepts of cloud computing including service & deployment models | **SDG9** | Industry, Innovation and Infrastructure | Understanding cloud service models and virtualization forms the foundation of modern digital infrastructure, enabling scalable, cost-effective IT services that support industrial innovation and business continuity. |
| **CO2** | make use of virtualization & containerization for cloud computing applications | **SDG9** | Industry, Innovation and Infrastructure | Virtualization and containerization are core enabling technologies that allow computing resources to be abstracted, optimized, and shared efficiently. Illustrating how these technologies work supports SDG 9 by fostering innovation in infrastructure design — making IT systems more modular, resource-efficient, and capable of supporting diverse industrial and enterprise workloads. |
| **CO3** | apply cloud-native principles including containerization with Docker, orchestration with Kubernetes & CI/CD pipelines for modern application delivery | **SDG8** | Decent Work and Economic Growth | Proficiency in Docker, Kubernetes, and CI/CD pipelines are among the most in-demand skills in the software industry. Applying these cloud-native practices prepares learners for high-quality technology employment, directly supporting SDG 8 by building human capital in a growing digital economy — enabling faster software delivery, productive DevOps workflows, and career-ready technical skills. |
| **CO4** | develop cloud-based applications using AWS & identify emerging cloud paradigms | **SDG9** | Industry, Innovation and Infrastructure | Developing cloud-based applications on platforms like AWS and exploring emerging paradigms (Quantum computing, Vehicular clouds) advances SDG 9 by cultivating |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| | | | | innovation capacity and practical infrastructure-building skills. Students learn to leverage industry-grade cloud platforms to design, deploy, and scale applications — directly contributing to the development of sustainable and resilient digital infrastructure. |

# INTRODUCTION TO FPGA DESIGN

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI602C** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply FPGA design flow concepts and programmable logic resources to implement basic digital systems using HDL

**CO2 :** utilize building blocks of Xilinx 7 series FPGA modules in developing digital systems

**CO3:** utilize building blocks of ultra-scale and CPLD/FPGA modules in developing digital systems

**CO4:** develop HDL-based arithmetic modules to synthesize them targeting modern FPGA platforms

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to FPGAs:** Evolution of programmable devices, FPGA design flow, applications of FPGA, Review of building blocks of Xilinx FPGA devices XC3000, XC4000: LUT, dedicated carry logic, I/O block and programmable interconnect

| **UNIT-II** | **9 Hrs** |
|---|---|

**Xilinx FPGA architectures:** Programming technologies, features of commercially available Xilinx FPGAs, Xilinx 7 series devices, Xilinx ultrascale devices.

**Building blocks of 7 series FPGAs:** CLBs, Block RAM, DSP blocks, I/O blocks, High speed transceivers, Routing structures, clock resources

| **UNIT-III** | **9 Hrs** |
|---|---|

**Advanced FPGA devices:** Building blocks of UltraScale FPGAs, configuration architecture; Building blocks of Xilinx Zynq 7000 series devices- APU, Cache, External memory interfaces, I/O peripherals, Interconnect, Programmable logic, JTAG, Serial transceivers, PCI express, ADCs

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Design examples using Xilinx FPGA:** 32-bit adder architectures, Multiplier architectures, 32-bit MIPS processor with DSP and multimedia instructions, Synthesis and implementation

**Textbook(s):**


1. John V. Oldfield, Richard C. Dorf, *Field-Programmable Gate Arrays: Reconfigurable Logic for Rapid Prototyping and ASIC Design*, 1st ed., New York: Wiley, 2008. (*Chapters 1-8*)
2. Stephen D. Brown, Robert J. Francis, Jonathan Rose, Zvonko G. Vranesic, *Field-Programmable Gate Arrays*, 1st ed., New York: Springer Publications, 1992. (*Chapters 1-4*)


**Reference Book(s):**


1. Stephen M. Trimberger, *Field-Programmable Gate Array Technology*, 1st ed., New York: Springer Publications, 1994.
2. Clive Maxfield, The Design Warrior's *Guide to FPGAs: Devices, Tools and Design*, 1st ed., Burlington: Elsevier, 2004.
3. Pong P. Chu, *FPGA Prototyping by Verilog Examples: Xilinx Spartan-3 Version*, 1st ed., Hoboken: Wiley, 2008.


**Web and Video link(s):**

1. https://nptel.ac.in/courses/117108040; *NPTEL. Digital System Design with PLDs and FPGAs. Prof. S. Srinivasan, IIT Madras.*

| **Course Articulation Matrix (CAM):** | | **U24CI602C: FPGA ARCHITECTURES** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI602C.1** | 1 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| **CO2** | **U24CI602C.2** | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| **CO3** | **U24CI602C.3** | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| **CO4** | **U24CI602C.4** | 2 | 2 | 2 | 3 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| **U24CI602C** | | **1.75** | **2** | **2** | **1.75** | **1.75** | **-** | **-** | **1** | **1** | **1.75** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply FPGA design flow concepts and programmable logic resources to model basic digital systems using HDL | **SDG4** | Quality Education | Applying FPGA design flow and HDL modeling strengthens practical digital design learning and modern technical education. |
| **CO2** | analyze architectures and building blocks of Xilinx 7 Series FPGA devices for suitable design implementation | **SDG9** | Industry, Innovation and Infrastructure | Analyzing FPGA architectures develops skills required for semiconductor innovation and programmable hardware infrastructure. |
| **CO3** | analyze architectures and building blocks of UltraScale and CPLD/FPGA devices for suitable design implementation | **SDG8** | Decent work and Economic Growth | Developing synthesizable FPGA modules enhances employability in VLSI, embedded systems, and automation industries |
| **CO4** | develop HDL-based arithmetic modules and synthesize them targeting modern FPGA platforms | **SDG9** | Industry, Innovation and Infrastructure | Designing Zynq SoC based systems promotes innovation in intelligent embedded platforms and industrial automation. |

# ADVANCED SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI602D** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply non-parametric methods to analyze the power spectral density and compare the techniques in terms of their computational requirements

**CO2 :** apply parametric methods based on stochastic process models to estimate the power spectral density of signals

**CO3:** analyze DFT & QMF filter banks and illustrate simple applications of multi-rate filter banks

**CO4:** outline the limitations of FTs and develop CWT/DWT for time/frequency analysis

| **UNIT-I** | **9 Hrs** |
|---|---|

**Non-Parametric Methods of Power Spectral Estimation**: Estimation of spectra from finite duration observations of a signal, Periodogram, Use of DFT in power spectral estimation, Bartlett -Welch and Blackman-Tukey methods, Comparison of performance of Non-parametric power spectrum estimation methods

| **UNIT-II** | **9 Hrs** |
|---|---|

**Parametric Methods of Power Spectrum Estimation:** Autocorrelation and its properties, Relation between auto correlation and model parameters, AR models - Yule-Walker, Least squares and Burg Methods; MA and ARMA models for power spectrum estimation

| **UNIT-III** | **9 Hrs** |
|---|---|

**Multi-rate Filter Banks:** Introduction to Multi-rate techniques, Multi-stage design of decimator and interpolator, FIR structures based on the polyphase decomposition, Implementation of Digital filter banks- DFT filter bank, Polyphase implementation; QMF filter banks- Structure and analysis, Applications: Sub-band coding of speech signals, Trans-multiplexers

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Wavelet Transforms:** Fourier transform and its limitations, Short time Fourier transform, Gabor transform, Continuous wavelet transform (CWT), Computation of CWT, Inverse wavelet transforms; Discrete wavelet transforms, Computation of DWT, Sub-band coding

**Textbook(s):**


1. J.G.Proakis & D. G.Manolakis , *Digital Signal Processing, Principles, Algorithms & Applications,* 3rd ed., Pearson, India, 1996. *(Chapters 10 and 12)*
2. Jaideva C Goswami, Andrew K Chan, *Fundamentals of Wavelets: Theory, Algorithms & Applications,* 2nd ed., John Wiley & Sons, India, 2010. *(Chapters 3 to 5)*


**Reference Book(s):**


1. P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, 1st ed., Prentice Hall, Englewood Cliffs, New Jersey, 1993.
2. N. J. Fliege, *Multirate Digital Signal Processing: Multirate Systems, Filter Banks, Wavelets*, 1st ed., John Wiley & Sons Ltd., 1999.
3. Sanjit. K. Mitra, *Digital Signal Processing –A computer based approach,* 4th ed., McGraw Hill, 2010.


**Web and Video link(s):**

1. http://elearn.psgcas.ac.in/nptel/courses/video/117101001/L01.html;
2. https://www.nptelprep.in/courses/108106151/materials;

| Course Articulation Matrix (CAM): | | U24CI602D: Advanced Signal Processing | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI602D.1 | 3 | 3 | 2 | 3 | 2 | - | – | - | - | - | 1 | 3 | 2 |
| CO2 | U24CI602D.2 | 3 | 3 | 2 | 3 | 2 | - | – | – | - | - | 1 | 3 | 2 |
| CO3 | U24CI602D.3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 1 | 1 | 3 | 2 |
| CO4 | U24CI602D.4 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | 1 | 1 | 3 | 2 |
| **U24CI602D** | | **3** | **3** | **2** | **2.75** | **2** | **-** | **-** | **-** | **-** | **1** | **1** | **3** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply non-parametric methods to analyze the power spectral density and compare the techniques in terms of their computational requirements | **SDG9** | Industry, Innovation & Infrastructure | The application of non-parametric PSD estimation techniques enhances signal analysis and system performance in modern engineering applications such as wireless communications, biomedical signal processing, and smart technologies, |
| **CO2** | apply parametric methods based on stochastic process models to estimate the power spectral density of signals | **SDG9** | Industry, Innovation & Infrastructure | Parametric PSD estimation techniques based on stochastic process models enable accurate spectral analysis in applications such as wireless communications, biomedical signal processing, to support the development of robust digital infrastructure |
| **CO3** | analyze DFT & QMF filter banks and illustrate simple applications of multi-rate filter banks | **SDG4** | Quality Education | The analysis of DFT and QMF filter banks and understanding multirate signal processing applications strengthens students' foundational knowledge in DSP. This enhances conceptual clarity in advanced topics such as spectral analysis, signal decomposition, and filter design. |
| **CO4** | outline the limitations of FTs and develop CWT/DWT for time/frequency analysis | **SDG11** | Sustainable Cities and Communities | Wavelet-based techniques enable efficient analysis of signals such as vibration monitoring in bridges and buildings, traffic pattern signals, environmental noise, power system disturbances, and smart sensor data in urban IoT networks. These applications help in early fault detection, structural health monitoring, and efficient resource management in smart cities. |

# EMBEDDED SYSTEMS WITH ARM PROCESSOR

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI603** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** identify architectural features of ARM processors

**CO2:** develop firmware for ARM based embedded systems

**CO3:** utilize memory, interrupts & exceptions in firmware development

**CO4:** make use of TM4C123 microcontroller board for embedded system development

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to ARM Processors**: Introduction to ARM processors, Evolution of ARM processors, pipeline organization, ARM Processor cores and CPU cores. Introduction to ARM Cortex-M Processors, ARM Cortex-M4 processor's architecture, Programmer's model, Special registers, Operation Modes

| **UNIT-II** | **9 Hrs** |
|---|---|

**ARM Cortex-M4 programming**: Assembly basics, Instruction set, Data transfer, Data processing, conditional and branch instructions, barrier and saturation operations, Cortex-M4-specific instructions, Thumb2 instructions, Keil Microcontroller Development Kit for ARM, Typical program compilation flow, Sample arithmetic and logical assembly language programs

| **UNIT-III** | **9 Hrs** |
|---|---|

**ARM cortex-M4 Memory Systems and interrupts**: Overview of memory system features, Memory map, Memory access attributes and permissions, Data alignment and unaligned data access support, Bit-band operations, Overview of exceptions and interrupts, Exception types, Overview of interrupt management, Definitions of priority, Vector table and vector table relocation, Software interrupts, Exception Handling

| **UNIT-IV** | **9 Hrs** |
|---|---|

**TM4C123 Microcontroller:** TM4C123 Microcontroller Block Diagram, The hardware development board for TM4C123, Microcontroller peripherals, Configuring microcontroller pins as GPIOs, Input – output interfacing for LED and Switch, Methods for input-output synchronization Configuration of interrupts and exceptions, UART, $I^2C$, SPI, CAN and ADC configuration

**Textbook(s):**


1. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*, 3rd ed., Oxford: Newnes Publications, 2013. *(Chapters 1 to 8 & 15)*
2. Muhammad Tahir and Kashif Javed, *ARM Microprocessor Systems – Cortex-M Architecture, programming and Interfacing*, Florida: CRC Press, 2017. *(Chapters 1 to 12)*


**Reference Book(s):**


1. Andrew N Sloss, Dominic Symes, Chris Wright, *ARM System Developer's Guide -Designing and Optimizing System Software*, San Francisco: Morgan Kaufmann Publishers, 2014.
2. Jonathan W Valvano, *Embedded Systems: Real time interfacing to ARM Cortex-M Microcontrollers*, 5th ed., Cambridge: Self Published, 2017.
3. Furber, Stephen Bo. *ARM system-on-chip architecture*, New Delhi: Pearson Education, 2000.


**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc22_ee116; *NPTEL Video Lecture on Embedded System Design with ARM by Prof. Indranil Sengupta & Prof. Kamalika Datta, Dept. of EE, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI603: Embedded Systems with ARM Processor | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI603.1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO2 | U24CI603.2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO3 | U24CI603.3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| CO4 | U24CI603.4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| U24CI603 | | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify architectural features of ARM processors | **SDG4** | Quality Education | This content of the course directly supports Target 4.4, which focuses on increasing the number of youth and adults who have relevant skills, for employment, decent jobs, and entrepreneurship. Mastering ARM architecture is a foundational skill for the global semiconductor and embedded systems industry. |
| **CO2** | develop firmware for ARM based embedded systems | **SDG9** | Industry, Innovation and Infrastructure | Inclusive Industrialisation (Target 9.2): Microcontrollers like the ARM Cortex-M4 are the "brains" of modern industrial machinery and automation systems, supporting the growth of domestic technology and industrial diversity.<br>Foster Innovation (Target 9.5): Learning to program development boards at the assembly level fosters innovation by allowing engineers to create highly efficient, specialized embedded systems |
| **CO3** | utilize memory, interrupts & exceptions in firmware development | **SDG9** | Industry, Innovation and Infrastructure | Target 9.5: Enhance scientific research, upgrade the technological capabilities of industrial sectors, and encourage innovation.<br>Mapping: The Cortex-M4 is a cornerstone of "Industry 4.0" and IoT. Efficient memory usage (bit-band aliasing) and real-time responsiveness (interrupt priorities) are critical for developing robust and resilient infrastructure. |
| **CO4** | make use of TM4C123 microcontroller board for embedded system development | **SDG11** | Sustainable Cities and Communities | EK-TM123GXL IDE board for designing applications related to smart homes, smart cities, industrial automation and developing firmware in embedded C |

# ANALOG AND DIGITAL COMMUNICATIONS

| | | | |
|---|---|---|---|
| **Class: B. Tech. VI – Semester** | | **Branch: ECI** | |
| **Course Code:** | **U24CI604** | **Credits:** | **3** |
| **Hours/Week (L-T-P-E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply the principles of analog communication systems to implement AM, DSB-SC, SSB-SC, and VSB modulation/demodulation techniques, including noise analysis in communication systems

**CO2:** analyze and apply angle modulation and analog pulse modulation techniques, and related signal generation and demodulation processes in communication systems

**CO3:** evaluate digital communication systems, source coding methods, quantization processes, and PCM/DM-based signal encoding schemes

**CO4:** compare digital modulation techniques such as ASK, PSK, FSK, DPSK, QPSK, and MSK with respect to their generation, detection, power efficiency, and bandwidth requirements in digital communication systems

| **UNIT-I** | **9 Hrs** |
|---|---|

**Amplitude Modulation:** Introduction, Elements of communication System, Amplitude modulation, Generation and demodulation of AM wave, Double sideband-suppressed carrier modulation, Generation and demodulation of DSB-SC wave, Costas receiver, Single sideband modulation, Generation and demodulation of SSB-SC wave, Vestigial sideband modulation, Noise in communication systems

| **UNIT-II** | **9 Hrs** |
|---|---|

**Angle Modulation:** Introduction, Frequency modulation, Phase modulation, relationship between FM and PM waves, Narrow-band frequency modulation, Wide-band frequency modulation, Transmission bandwidth of FM waves, Generation and demodulation of FM signals, Phase locked loop, Pre-emphasis and de-emphasis

**Analog Pulse Modulation:** Introduction, Sampling theorem, Sampling techniques, Types of Analog pulse modulation, Pulse-amplitude modulation (PAM), Pulse width modulation (PWM), Pulse-position modulation (PPM)

| **UNIT-III** | **9 Hrs** |
|---|---|

**Information Theory:** Introduction, Elements of digital communication system, Discrete memoryless source (DMS), Measure of information, Entropy, Information rate, Discrete memoryless channels (DMC), Source coding- Shannon-Fano coding, Huffman coding

**Waveform Coding Techniques:** Quantization, Quantization error, Signal to quantization noise ratio, Pulse code modulation (PCM), Delta modulation (DM), Adaptive delta modulation (ADM), Comparison of PCM and DM

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Digital Modulation Techniques:** Introduction, Types of Digital modulation schemes, Amplitude shift keying (ASK), Phase shift keying (PSK), Frequency shift keying (FSK), Differential phase shift keying (DPSK), Quadrature phase shift keying (QPSK), Minimum shift keying (MSK), Power and bandwidth requirements of above schemes

**Textbook(s):**


1. Simon Haykin and Michael Moher *Introduction to Analog and Digital Communications*, 2nd ed. United States of America: John Wiley & sons, inc., 2007. *(Chapters: 3,4,5,7,9)*


**Reference Book(s):**


1. Herbart Taub, Donald L Schilling, *Principles of Communication Systems*, 3rd ed, 2007
2. R.P.Singh and S.D.Sapre, *Communication Systems (Analog and Digital)*, McGraw-Hill

Education, 2nd ed, 2008

3. Bhattacharya, *Digital Communication*, Tata McGraHill Education, 2014.
4. K. Sam Shanmugam, *Digital and Analog Communication Systems*, New *Delhi:John Wiley*& Sons, 2008.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/117105143; *NPTEL Video Lecture on Analog Communication by Prof. Goutam Das, Dept. of EE, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI604 : ANALOG AND DIGITAL COMMUNICATIONS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI604.1 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | 1 | 2 | 1 | 1 |
| CO2 | U24CI604.2 | 3 | 3 | 2 | 2 | 1 | - | - | - | - | 1 | 2 | 1 | 1 |
| CO3 | U24CI604.3 | 3 | 3 | 2 | 3 | 2 | - | - | - | - | 1 | 2 | 1 | 1 |
| CO4 | U24CI604.4 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 1 | 2 | 1 | 1 |
| **U24CI604** | | **3** | **3** | **2** | **2.25** | **1.5** | **-** | **-** | **-** | **-** | **1** | **2** | **1** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply the principles of analog communication systems to implement AM, DSB-SC, SSB-SC, and VSB modulation/ demodulation techniques, including noise analysis in communication systems | **SDG9** | Industry, Innovation & Infrastructure | Communication technologies support modern industrial infrastructure and innovation in broadcasting and telecommunication systems. |
| **CO2** | analyze and apply angle modulation and analog pulse modulation techniques, and related signal generation and demodulation processes in communication systems | **SDG9** | Industry, Innovation & Infrastructure | Advanced modulation techniques contribute to reliable communication infrastructure and technical skill development in engineering education. |
| | | **SDG4** | Quality Education | |
| **CO3** | evaluate digital communication systems, source coding methods, quantization processes, and PCM/DM-based signal encoding schemes | **SDG9** | Industry, Innovation & Infrastructure | Digital communication systems enable modern industries, digital services, and employment opportunities in communication and IT sectors. |
| | | **SDG8** | Decent Work & Economic Growth | |
| **CO4** | compare digital modulation techniques such as ASK, PSK, FSK, DPSK, QPSK, and MSK with respect to their generation, detection, power efficiency, and bandwidth requirements in digital communication systems | **SDG7** | Affordable and Clean Energy | Efficient digital modulation techniques improve bandwidth and power utilization, supporting energy-efficient communication technologies and sustainable infrastructure. |
| | | **SDG9** | Industry, Innovation & Infrastructure | |

# SYSTEM VERILOG FOR VERIFICATION

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI605** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** utilize system Verilog standards & data types in HDL modelling

**CO2:** apply system Verilog concepts to verify the functionality of complex digital circuits

**CO3:** develop constrained random testbench programs in system Verilog

**CO4:** examine verification quality using functional coverage metrics and implement cover groups

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to System Verilog:** System Verilog standards, System Verilog enhancements for hardware design, Advantages of system Verilog

**Data types:** Verilog data types, System Verilog data types, Two state data types- Bit, byte, shortint, int, longint; Four state data types- Logic, Enumerated data types, User defined data types, Struct data types, Strings, Packages, Type conversion: dynamic casting, Static casting

**Memories:** Arrays, Dynamic arrays, Multidimensional arrays, Packed arrays, Associative arrays, Queues, Array methods

| **UNIT-II** | **9 Hrs** |
|---|---|

**Connecting the Test Bench and Design:** Separating the test bench and design, The interface construct, Stimulus timing, Interface driving and sampling, System Verilog assertions

**Procedural statements and routines:** Procedural statements, Tasks, Functions and void functions, Task and function overview, Routine arguments, Returning from a routine, Local data storage, Time values

| **UNIT-III** | **9 Hrs** |
|---|---|

**Randomization:** Introduction, Randomization in system Verilog, Constraint details, Solution probabilities, Valid constraints, Inline constraints, Random number functions, Common randomization problems, Random control, Random number generators

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Functional Coverage:** Introduction, Coverage types, Functional coverage strategies, Anatomy of a cover group, Triggering a cover group, Data sampling, Cross coverage, Coverage options, Parameterized cover groups

**Textbook(s):**


1. Chris Spear, *System Verilog for Verification – A guide to learning the Test bench language features*, 2nd ed., New York: Springer Publications, 2010. *(Chapters 3, 5, 6 and 9)*
2. Stuart Sutherland, Simon Davidmann, Peter Flake, *System Verilog for Design- A guide to using system Verilog for Hardware design and modelling*, 2nd ed., New York: Springer Publications, 2006. *(Chapters 1-5)*


**Reference Book(s):**


1. Janick Bergeron, *Writing Testbenches using System Verilog*, 1st ed., New York: Springer Publications, 2006.
2. Doulos, *System Verilog Golden Reference Guide: A concise guide to System Verilog*, Version 5.0, Ringwood: Doulos, 2010.
3. Sasan Iman, *Step-by-Step Functional Verification with System Verilog and OVM*, 1st ed., Seattle: Hansen Brown Publishing Company, 2008.

4. Janick Bergeron, Eduard Cerny, Alan Hunter, Andrew Nightingale, *Verification Methodology Manual for System Verilog*, 1st ed., New York: Springer Publications, 2005.

**Web and Video link(s):**

1. www.asic-world.com/systemverilog/index.html: *Tutorials, examples, links, tools and books related to System Verilog.*

| Course Articulation Matrix (CAM): | | U24CI605: SYSTEM VERILOG FOR VERIFICATION | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI605.1 | 1 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| CO2 | U24CI605.2 | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| CO3 | U24CI605.3 | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | U24CI605.4 | 2 | 2 | 2 | 3 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| **U24CI605** | | **1.75** | **2** | **2** | **1.75** | **1.75** | **-** | **-** | **1** | **1** | **1.75** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | utilize system Verilog standards & data types in HDL modelling | **SDG9** | Industry, Innovation and Infrastructure | The inclusion of System Verilog standards and enhancements over Verilog equips learners with industry-relevant design and verification skills aligned with current VLSI and embedded system practices. This directly contributes to building a skilled engineering workforce, which is a key requirement for sustainable industrial growth. |
| **CO2** | apply system Verilog concepts to verify the functionality of complex digital circuits | **SDG4** | Quality Education | Connecting the Test Bench and design and Procedural Statements and Routines strongly aligns with Quality Education by enabling the delivery of industry-relevant, skill-oriented, and outcome-based technical education in the domain of hardware design and verification. |
| **CO3** | develop constrained random testbench programs in system Verilog | **SDG8** | Decent work and Economic Growth | Randomization in system Verilog directly supports Decent Work and Economic Growth by developing specialized skills in functional verification, a high-demand domain within the semiconductor and electronics industry. |
| **CO4** | examine verification quality using functional coverage metrics and implement cover groups | **SDG9** | Industry, Innovation and Infrastructure | The introduction to coverage types, functional coverage strategies, and cover group architecture equips learners with industry-standard techniques to measure design completeness and correctness. |

# UNIVERSAL HUMAN VALUES - II

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** Common to all branches | |
| **Course Code:** | **U24IK606B** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **2-0-0-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **24 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** describe harmony within the individual by understanding the distinct roles of the self and the body

**CO2 :** analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society

**CO3:** explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfilment among all orders of nature

**CO4:** apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being

| **UNIT-I** | **6 Hrs** |
|---|---|

**Course Introduction:** Need, Basic guidelines, Content and process for value education **Self-Exploration**: 'Natural acceptance' and Experiential validation, Basic human aspirations, Right understanding, Relationship and physical facility, Fulfilment of aspirations, Understanding happiness and prosperity, Harmony at various levels

**Understanding Harmony in the Human Being**: Harmony in myself, Understanding human being, Understanding the harmony of self with the body, Harmony in self-health, Program for self and health

| **UNIT-II** | **6 Hrs** |
|---|---|

**Understanding Harmony in the Family:** Harmony in human-Human relationship, Understanding values in human-human relationship, Meaning of Justice (Universal values in relationships), Mutual happiness

**Understanding Harmony in the Society:** Harmony in the society, Visualizing a universal harmonious order in society-undivided society, Universal order-From family to world family

| **UNIT-III** | **6 Hrs** |
|---|---|

**Understanding Harmony in the Nature:** Whole existence as coexistence, Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature, Recyclability and Self-regulation in nature

**Understanding Harmony in the Existence:** Understanding existence as co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence

| **UNIT-IV** | **6 Hrs** |
|---|---|

**Professional Ethics:** People friendly and eco-friendly production systems, Appropriate technologies and management patterns

**Case Studies:** Case studies of typical holistic technologies, Management models and production systems

**Textbooks:**


3. R.R. Gaur, R. Sangal and G. P. Bagaria, *Human Values and Professional Ethics*, New Delhi Excel Books, 2010.


**Reference Book(s):**


1. A.Nagaraj, *Jeevan Vidya: Ek Parichaya*, Raipur: Jeevan Vidya Prakashan, Amarkantak, 2018.

2. A.N. Tripathi, *Human Values*, New Age International Publisher, 3rded., New Delhi, 2019.
3. M. Govindrajran, S. Natrajan & V.S. Senthil Kumar, *Engineering Ethics (includes Human Values)*, PHI Learning Pvt. Ltd., 12th ed., Haryana, 2011.
4. Jayshree Suresh, B. S. Raghavan, *Human Values & Professional Ethics*, 4thed., S. Chand & Co. Ltd., New Delhi, 2012.

**Additional Resources:**

1. A set of DVDs containing - Video of Teachers‟ Orientation Program - PPTs of Lectures and Practice Sessions (*Audio-visual material for use in the practice sessions*)

**Web and Video link(s):**

3. https://fdp-si.aicte-india.org/UHVII.php

| Course Articulation Matrix | | U24IK606B Universal Human Values - II | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24IK606B.1 | 2 | 1 | - | - | - | 1 | - | 3 | - | - | - | 1 | 1 |
| CO2 | U24IK606B.2 | - | 2 | - | - | - | 3 | - | 3 | 2 | 2 | - | - | 1 |
| CO3 | U24IK606B.3 | 1 | 2 | - | - | - | 2 | 3 | 2 | - | - | - | 1 | 1 |
| CO4 | U24IK606B.4 | 1 | 2 | - | - | - | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 1 |
| U24IK606B | | **1** | **1.75** | - | - | - | **2.25** | **1.5** | **2.75** | **1** | **1** | **0.75** | **1** | **1** |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | describe harmony within the individual by understanding the distinct roles of the self and the body | **SDG 4** | Quality Education | Develops self-awareness, values, ethical thinking, and holistic education for responsible citizenship. |
| **CO2** | analyze values in human relationships and apply the principles of justice, mutual happiness, and harmony in family and society | **SDG 16** | Peace, Justice and Strong Institutions | Promotes justice, mutual respect, harmonious relationships, and peaceful societies. |
| **CO3** | explain the interconnectedness of nature and existence and evaluate the concept of coexistence and mutual fulfillment among all orders of nature | **SDG 13** | Climate Action | Enhances understanding of ecological balance, coexistence, environmental sustainability, and conservation. |
| | | **SDG 15** | Life on Land | |
| **CO4** | apply professional ethics and sustainable practices in engineering and professional activities for societal and environmental well-being | **SDG 9** | Industry, Innovation and Infrastructure; | Encourages ethical professional practices, sustainable technologies, and environmentally responsible production systems. |
| | | **SDG 12** | Responsible Consumption and Production | |

# INTERNET OF THINGS LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI607** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** design and configure IoT-based systems for security and access control using Cisco Packet Tracer and related simulation tools.

**CO2:** interface and program hardware components such as sensors, actuators, and microcontrollers (Raspberry Pi) to build real-world IoT monitoring systems

**CO3:** implement embedded communication protocols (I2C, MQTT) and Linux-based GPIO control for IoT device-to-device communication.

**CO4:** develop IoT cloud-connected applications using RESTful APIs, WebSockets, and automation platforms for remote monitoring and data visualization.

**LIST OF EXPERIMENTS**

1. Build and configure an IoT-based intruder detection system in Cisco Packet Tracer.
2. Build and configure a network to control door access using an RFID reader in Cisco Packet Tracer
3. Build and configure a smart access control system in Cisco Packet Tracer using RFID, Bluetooth, and a smartphone.
4. Build and configure a fire monitoring system in Cisco Packet Tracer using an MCU, fire monitor, ceiling sprinkler, and a simulated heating element.
5. Raspberry Pi setup, GPIO interfacing with LED, buzzer and proximity sensor
6. Interfacing Temperature & Humidity Sensor (DHT11) to Raspberry Pi
7. Controlling servo motor using Raspberry Pi
8. Implementation of I2C communication - MPU6050 (Accelerometer + Gyroscope) interfacing with Raspberry Pi
9. Accessing GPIO of Raspberry Pi using Linux Command Line
10. Implementation of MQTT Protocol – Publish/Subscribe with Raspberry Pi
11. Networking with RESTful APIs and Web Sockets Using Flask
12. Sending IoT Data to ThingSpeak Cloud Dashboard
13. IoT application development using IFTTT automation platform

**Textbook(s):**


1. Charith Perera and Nhat Pham, *Internet of Things: Systems Design Lab Book with Packet Tracer,* Cardiff IoT Group, UK, 2025.
2. Gary Smart, *Practical Python Programming for IoT, Packt Publishing,* 1st ed, UK, 2020.


**Reference Book(s):**


1. Muhammad Azhar Iqbal, Huanlai Xing et al, *Enabling the Internet of Things: Fundamentals, Design, and Applications,* John Wiley &Sons, 1st ed, NJ, 2021.
2. Arshdeep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach,* Universities Press, India, 1st ed., 2014.

**Web and Video link(s):**

1. http://nptel.ac.in/courses/106105166; *NPTEL Video Lectures on Internet of Things by Prof. Sudip Misra, IIT Kharagpur.*

**Laboratory Manual:**

1. Manual for *Internet of Things Laboratory* prepared by faculty of Department of ECIE, KITSW.

| **Course Articulation Matrix (CAM):** | | **U24CI607: INTERNET OF THINGS LABORATORY** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO 3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | U24CI607.1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO2** | U24CI607.2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO3** | U24CI607.3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **CO4** | U24CI607.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **U24CI607** | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | design and configure IoT-based systems for security and access control. | **SDG 11** | Sustainable Cities and Communities | IoT-based intruder detection and RFID access control systems contribute to safer, smarter urban environments. Simulation of smart access infrastructure supports the development of secure and sustainable city solutions. |
| **CO2** | interface hardware components (sensors, actuators, Raspberry Pi) for IoT monitoring. | **SDG 3** | Good Health and Well-being | Fire monitoring, temperature/ humidity sensing, and proximity detection using Raspberry Pi support health-related IoT applications such as environment monitoring in hospitals, smart homes, and industrial safety systems. |
| **CO3** | implement I2C, MQTT, and Linux GPIO for IoT device communication. | **SDG 9** | Industry, Innovation and Infrastructure | Implementation of industry-standard communication protocols (I2C, MQTT) and Linux-based embedded programming supports the development of robust IoT infrastructure essential for smart industries and innovation ecosystems. |
| **CO4** | develop cloud-connected IoT applications using APIs, WebSockets, and automation platforms. | **SDG 13** | Climate Action | Cloud-connected IoT systems that collect and visualize real-time environmental data (via ThingSpeak, IFTTT) enable climate monitoring and data-driven decision-making, supporting environmental sustainability and climate action initiatives. |

# ANALOG AND DIGITAL COMMUNICATIONS LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI608** | **Credits:** | **1** |
| **Hours/Week (L-T-P-E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** implement and analyze analog modulation and demodulation techniques such as AM, DSB-SC, and FM to determine the modulation index and percentage modulation.

**CO2:** design and evaluate analog pulse modulation systems including PAM, PWM, PPM, and Delta Modulation for signal transmission applications.

**CO3:** develop and test digital modulation and demodulation schemes such as ASK, PSK, FSK, and DPSK for digital communication systems.

**CO4:** simulate and interpret the performance of analog and digital communication techniques using MATLAB and analyze their waveform characteristics and system parameters.

**LIST OF EXPERIMENTS**

1. Amplitude Modulation and Demodulation
2. DSB-SC Modulation and Demodulation
3. Frequency Modulation and Demodulation
4. Observe the effects of Pre-emphasis and De-emphasis on given input signal
5. Pulse Amplitude Modulation and Demodulation
6. Generation & Demodulation of Pulse Width Modulation
7. Generation & Demodulation of Pulse Position Modulation
8. Delta Modulation and Demodulation
9. Generation & Demodulation of Pulse Code Modulation
10. Generation and evaluation of variable length source code using Huffman coding
11. Amplitude Shift Keying (ASK)
12. Phase Shift Keying (PSK)
13. Frequency Shift Keying (FSK)
14. Modulation and demodulation of Differential Phase Shift Keying (DPSK) signal
15. MATLAB Simulation of AM, FM, ASK, FSK and PSK

**Textbook(s):**

1. Simon Haykin, *Communications Systems*, 4th ed. Singapore: John Wiley & Sons, Inc. 2004.

**Reference Book(s):**

1. Herbart Taub, Donald L Schilling, *Principles of Communication Systems*, 3rd ed, 2007
2. R.P. Singh and S.D. Sapre, *Communication Systems (Analog and Digital)*, McGraw-Hill Education, 2nd ed, 2008
3. Bhattacharya, *Digital Communication*, Tata McGraHill Education, 2014.
4. K. Sam Shanmugam, *Digital and Analog Communication Systems*, New *Delhi:John Wiley*& Sons, 2008.

**Laboratory Manual:**

1. Manual for *Analog and Digital Communications Laboratory* prepared by faculty of

| Course Articulation Matrix (CAM): | | U24CI608: ANALOG AND DIGITAL COMMUNICATIONS LABORATORY | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI608.1 | 3 | 3 | 2 | 3 | 2 | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO2 | U24CI608.2 | 3 | 3 | 3 | 2 | 2 | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO3 | U24CI608.3 | 3 | 3 | 3 | 3 | 2 | - | - | - | 1 | 1 | 2 | 2 | 2 |
| CO4 | U24CI608.4 | 2 | 3 | 2 | 3 | 3 | - | - | - | 1 | 1 | 3 | 2 | 2 |
| **U24CI608** | | **2.75** | **3** | **2.5** | **2.75** | **2.25** | **-** | **-** | **-** | **1** | **1** | **2.25** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | implement and analyze analog modulation and demodulation techniques such as AM, DSB-SC, and FM to determine the modulation index and percentage modulation. | **SDG4** | Quality Education | Practical exposure to communication systems enhances technical education and supports industrial communication technologies. |
| | | **SDG9** | Industry, Innovation & Infrastructure | |
| **CO2** | design and evaluate analog pulse modulation systems including PAM, PWM, PPM, and Delta Modulation for signal transmission applications. | **SDG9** | Industry, Innovation & Infrastructure | Efficient pulse modulation techniques contribute to modern communication infrastructure and energy-efficient signal transmission. |
| | | **SDG7** | Affordable and Clean Energy | |
| **CO3** | develop and test digital modulation and demodulation schemes such as ASK, PSK, FSK, and DPSK for digital communication systems. | **SDG8** | Decent Work & Economic Growth | Digital communication skills support employability, industrial applications, and advancements in telecommunication systems. |
| | | **SDG9** | Industry, Innovation & Infrastructure | |
| **CO4** | simulate and interpret the performance of analog and digital communication techniques using MATLAB and analyze their waveform characteristics and system parameters. | **SDG4** | Quality Education | MATLAB-based simulation develops analytical and problem-solving skills required for innovation and modern engineering education. |
| | | **SDG9** | Industry, Innovation & Infrastructure | |

# EMBEDDED SYSTEMS WITH ARM PROCESSOR LABORATORY

| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
|---|---|---|---|
| **Course Code:** | **U24CI609** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** develop embedded C programs for ARM microcontrollers to interface display devices & use UART for serial communication

**CO2:** develop embedded C programs for implementing accurate time delay using counters

**CO3:** develop embedded C programs for implementing exception handlers & interrupt services

**CO4:** develop embedded C programs for interfacing temperature sensor with ARM Microcontrollers

**LIST OF EXPERIMENTS**

1. Reading switches and displaying on LEDs
2. Initializing and displaying message on LCD display
3. Transmitting data using UART
4. Receiving data using UART
5. Toggling LED using SysTick counter
6. Implementing delay function using Timers
7. Using GPIOF interrupt
8. Using SysTick interrupt
9. Interrupt priority demonstration
10. Interfacing LM34 temperature sensor
11. Communicating with Real time clock using I2C
12. Using PWM module to control LED intensity

**Laboratory Manual:**

1. Manual for *Embedded systems with ARM processor Laboratory* prepared by faculty of Department of ECIE, KITSW

**Reference Book(s):**

1. Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, SepehrNaimi, *TI ARM Peripherals Programming and Interfacing Using C Language for ARM Cortex*, Texas: Mazidi and Naimi, 2014.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc22_ee116/preview; *NPTEL Video Lecture on Embedded System Design with ARM by By Prof. Indranil Sengupta & Prof. Kamalika Datta, Dept. of EE, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI609: EMBEDDED SYSTEMS WITH ARM PROCESSOR LABORATORY | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI609.1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO2 | U24CI609.2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO3 | U24CI609.3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| CO4 | U24CI609.4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 |
| **U24CI609** | | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | develop embedded C programs for ARM microcontrollers to interface display devices & use UART for serial communication | **SDG4** | Quality Education | By learning these technical skills, you are building specialized ICT (Information and Communication Technology) skills that directly contribute to increasing the number of youth and adults with relevant skills for employment and entrepreneurship |
| **CO2** | develop embedded C programs for implementing accurate time delay using counters | **SDG9** | Industry, Innovation and Infrastructure | This goal targets upgrading technological capabilities and fostering innovation. Learning to program microcontrollers like the ARM Cortex-M—the standard for low-cost, power-efficient processing—directly builds the technical capacity needed for modern industrial infrastructure |
| **CO3** | develop embedded C programs for implementing exception handlers & interrupt services | **SDG11** | Sustainable Cities and Communities | Real-time processing through efficient interrupt handling is essential for smart city applications, such as intelligent lighting and traffic management systems. These technologies improve urban efficiency and reduce environmental impact |
| **CO4** | develop embedded C programs for interfacing temperature sensor with ARM Microcontrollers | **SDG9** | Industry, Innovation and Infrastructure | Microcontrollers and sensors form the "fundamental backbone" of modern industrial IoT and smart infrastructure. Context: Developing programs for data acquisition and real-time monitoring is critical for building resilient industrial systems and driving innovation in automation |

# MINI PROJECT

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | U24CI610 | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-1** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **-** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**:

*After completion of this course, the students should be able to,*

**CO1:** apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship

**CO2:** demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report

**CO3:** make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project

**CO4:** write a "Mini project paper" in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project

*Student has to take up independent mini project on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study, which would supplement and complement the program assigned to each student.*

*Guidelines:*

1. The HoD shall constitute a *Department Mini Project Evaluation Committee (DMINPEC)*
2. *DMPEC* shall allot a faculty supervisor to each student for guiding on (i) selection of topic (ii) literature survey and work to be carried out (iii) preparing a report in proper format and (iv) effective mini project oral presentation
3. There shall be only continuous Internal Evaluation (CIE) for Mini Project
4. The CIE for mini project is as follows:

| Assessment | Weightage |
|---|---|
| **Mini Project Supervisor Assessment** | **20%** |
| **Working model / process / software package / system developed** | **20%** |
| Mini Project report | 15% |
| Mini Project paper | 5% |
| Video pitch | 5% |
| **DMINPEC Assessment**: *Oral presentation with PPT and viva-voce* | 20% |
| SDG Alignment | 10% |
| Research Alignment | 5% |
| **Total Weightage:** | **100%** |

**Note:** It is mandatory for the student to appear for oral presentation and viva-voce to qualify for course evaluation

(aa) **Mini Project Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals / Technical Magazines on the topics of potential interest

(bb) **Working Model**: Each student is requested to develop a working model / process / system on the chosen work and demonstrate before the *DMINPEC* as per the dates specified by *DMINPEC*

(cc) **Report:** Each student is required to submit a well-documented report on the chosen seminar topic as per the format specified by *DMINPEC*

(dd) **Anti-Plagiarism Check:** The seminar report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(ee) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *DMPEC* as per the schedule notified by the department

(ff) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact

(gg) The student has to register for the Mini project as supplementary examination in the following cases:

xii) he/she is absent for oral presentation and viva-voce

xiii) he/she fails to submit the report in prescribed format

xiv) he/she fails to fulfill the requirements of Mini project evaluation as per specified guidelines

xv) The CoE shall send a list of students registered for supplementary to the HoD concerned

xvi) The DMINPEC, duly constituted by the HoD, shall conduct Mini project evaluation and send the award list to the CoE within the stipulated time

| **Course Articulation Matrix (CAM):** | | **U24CI610 Mini Project** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | U24CI610.1 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 2 | 1 |
| **CO2** | U24CI610.2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 1 |
| **CO3** | U24CI610.3 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 3 | 1 | 2 | 1 | 1 |
| **CO4** | U24CI610.4 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 1 |
| **U24CI610** | | **1.75** | **2** | **1.5** | **2.25** | **2.25** | **1.5** | **1.25** | **1.52** | **2.25** | **1.25** | **2.25** | **1.25** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation & entrepreneurship | **SDG 9** | Industry, Innovation and Infrastructure | Mini projects involve the design and development of innovative solutions such as IoT systems, embedded systems, communication networks, VLSI applications, and intelligent electronic devices. These activities promote technological innovation, entrepreneurship, and sustainable industrial infrastructure. |
| **CO2** | demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report | **SDG 4** | Quality Education | Literature review, problem analysis, technical documentation, and independent learning enhance research skills, critical thinking, and lifelong learning capabilities, thereby supporting quality technical education and knowledge creation. |
| **CO3** | make an effective oral presentation through informative PPTs, showing knowledge on the subject & sensitivity towards social impact of the Mini project | **SDG 11** | Sustainable Cities and Communities | Presentation and discussion of ECI-based solutions for smart cities, intelligent transportation systems, environmental monitoring, public safety, healthcare technologies, and digital connectivity contribute to sustainable and inclusive community development. |
| **CO4** | write a "Mini project | **SDG 12** | Responsible | Scientific reporting and dissemination of |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| | paper" in scientific journal style & format from the prepared Mini project report and create a video pitch on Mini project | | Consumption and Production | project outcomes promote responsible innovation, ethical publication practices, efficient utilization of resources, and sustainable technology development. |

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కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
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(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
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# III Year
# Exit Courses
# Syllabi

# FPGA ARCHITECTURES

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VI – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI610X** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **16 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

*(based on cognitive skills acquired from theory component)*

**CO1 :** apply FPGA design flow concepts and programmable logic resources to implement basic digital systems using HDL

**CO2 :** utilize building blocks of Xilinx 7 series FPGA modules in developing digital systems

**CO3 :** utilize building blocks of ultraScale and CPLD/FPGA modules in developing digital systems

**CO4 :** develop HDL-based arithmetic modules to synthesize them targeting modern FPGA platforms

*(based on psychomotor skills acquired from laboratory component)*

**CO5 :** utilize FPGA boards for the implementation of combinational circuits

**CO6 :** utilize FPGA boards for the implementation of sequential circuits

**CO7 :** apply System Verilog concepts for the verification of combinational circuits

**CO8 :** apply System Verilog concepts for the verification of combinational circuits

| **THEORY COMPONENT** | |
|---|---|
| **UNIT-I** | **4 Hrs** |
| **Introduction to FPGAs:** Evolution of programmable devices, FPGA design flow, applications of FPGA, Review of building blocks of Xilinx FPGA devices XC3000, XC4000 | |
| **UNIT-II** | **4 Hrs** |
| **Xilinx FPGA architectures:** Programming technologies, features of commercially available Xilinx FPGAs, Xilinx 7 series devices, Xilinx ultrascale devices. | |
| **UNIT-III** | **4 Hrs** |
| **Advanced FPGA devices:** Building blocks of UltraScale FPGAs, configuration architecture. Building blocks of Xilinx Zynq 7000 series devices: APU, Cache, External memory interfaces, I/O peripherals, Interconnect | |
| **UNIT-IV** | **4 Hrs** |
| **Design examples using Xilinx FPGA:** 32-bit adder architectures, Multiplier architectures, 32-bit MIPS processor with DSP and multimedia instructions | |
| **LABORATORY COMPONENT** | |
| **List of Experiments**<br>11. FPGA implementation 4-bit Adder using Verilog HDL | |

12. FPGA implementation 4-bit ALU using Verilog HDL
13. FPGA implementation of 4-bit Asynchronous counter
14. Design and verification of Multiplexers using System Verilog
15. Design and verification of Flip-flops and Latches using System Verilog
16. Design Single Port RAM Asynchronous Read/Write using System Verilog

**Textbook(s):**

4. Stephen M. Trimberger, *Field-Programmable Gate Array Technology*, 1st ed., New York: Springer Publications, 1994.

**Reference Book(S):**

7. John V. Oldfield, Richard C. Dorf, *Field-Programmable Gate Arrays: Reconfigurable Logic for Rapid Prototyping and ASIC Design*, 1st ed., New York: Wiley, 2008. (Chapters 1-8)
8. Stephen D. Brown, Robert J. Francis, Jonathan Rose, Zvonko G. Vranesic, *Field-Programmable Gate Arrays*, 1st ed., New York: Springer Publications, 1992. (Chapters 1-4)
9. Clive Maxfield, The Design Warrior's *Guide to FPGAs: Devices, Tools and Design*, 1st ed., Burlington: Elsevier, 2004.
10. Pong P. Chu, *FPGA Prototyping by Verilog Examples: Xilinx Spartan-3 Version*, 1st ed., Hoboken: Wiley, 2008.

**Web and Video link(s):**

https://nptel.ac.in/courses/117108040; NPTEL. Digital System Design with PLDs and FPGAs. Prof. S. Srinivasan, IIT Madras. National Programme on Technology Enhanced Learning (NPTEL), SWAYAM.

| Course Articulation Matrix (CAM): | | U24CI610X : INTRODUCTION TO FPGA DESIGN | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI610X.1 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO2 | U24CI610X.2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO3 | U24CI610X.3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO4 | U24CI610X.4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO5 | U24CI610X.5 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO6 | U24CI610X.6 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO7 | U24CI610X.7 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| CO8 | U24CI610X.8 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| U24CI610X | | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

# PROCESS CONTROL

| | | | |
|---|---|---|---|
| **Class:** B.Tech. III –Semester (Exit) | | **Branch:** ECIE | |
| **Course Code:** | **U24CI611X** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-0-2-0-4** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **16 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

| | |
|---|---|
| **CO1:** | identify building blocks of automation control system and apply discontinuous controller modes of operation for process control applications |
| **CO2:** | apply continuous controller modes of operation for process control and estimate the controller tuning parameters using one-quarter decay ratio, C-C & Z-N techniques |
| **CO3:** | utilize multiple loop/ advanced control configurations for different process control applications |
| **CO4:** | utilize automated control configurations (PLC, SCADA & DCS) for different process control applications |
| **CO5:** | simulate single loop & multiple loop controllers using SIMULINK software |
| **CO6:** | examine the performance of ON-OFF, P, PI & PID controllers for single loop process control systems like temperature, pressure, level & flow controllers |
| **CO7:** | examine the performance of ON-OFF, P, PI & PID controllers for cascade control configuration |
| **CO8:** | develop ladder diagram programs for PLC |

| **UNIT-I** | **4 Hrs** |
|---|---|

**Introduction to Industrial Automation :** Automation pyramid -- Field, Control, Supervisory, Planning and Management levels;

Open-loop vs. Closed-loop systems -- characteristics; Discontinuous controller modes -- ON-OFF and Multi-position controllers

| **UNIT-II** | **4 Hrs** |
|---|---|

**Continuous Controller Modes:** Continuous controller modes -- Proportional (P), Integral (I), Derivative (D), PI, PD & PID -- response characteristics;

**Controller tuning methods**: One-quarter decay ratio, Cohen-Coon and Ziegler-Nichols techniques

| **UNIT-III** | **4 Hrs** |
|---|---|

**Multi-loop Control Configurations :** Multiple-loop control -- Cascade control, Feedforward control, Feedforward & feedback control (FFFBC);

**Advanced Control Configurations** Advanced control -- Adaptive control and Multivariable control (overview)

| **UNIT-IV** | **4 Hrs** |
|---|---|

**Automated Control Systems:** Supervisory Control and Data Acquisition (SCADA) -- architecture, RTUs, MTUs, HMI; Programmable Logic Controller (PLC) -- hardware architecture and ladder logic programming basics; Distributed Control System (DCS) -- architecture overview

**LABORATORY COMPONENT**

**LIST OF EXPERIMENTS**

1. Simulation and Analysis of open loop and closed loop systems using SIMULINK
2. Process Dynamics with and without Transport Delay using SIMULINK
3. Tuning of controllers using SIMULINK
4. Response analysis of Level process using ON-OFF, P, PI, PD & PID controller modes
5. Response analysis of Flow process using ON-OFF, P, PI, PD & PID controller modes
6. Response analysis of Pressure process using ON-OFF, P, PI, PD & PID controller modes
7. Response analysis of level-flow integrated process using cascade control configuration
8. Implementation of ladder logic for logical functions, traffic control & other industrial applications using PLC

**Textbook(s):**

1. G. Stephanopoulos, *Chemical Process Control*, 6th ed., PHI, 1998. (*Chapters 5, 10, 11, 13, 14, 16, 18, 20 to 23*)
2. Surekha Bhanot, *Process Control: Principles and Applications*, 6th ed., Oxford University Press, 2011. (*Chapters 1 to 6, 8, 10 to 12*)

**Reference Book(s):**

1. C.D. Johnson, *Process Control Instrumentation Technology*, 4th ed., PHI, 1996
2. D.R. Coughanowr, *Process Systems Analysis and Control*, 3rd ed., McGraw Hill, New York, 2009.
3. B.G. Liptak, *Instrument Engineers Hand Book, Vol.III*, 4th ed., Chilton book co., Philadelphia, 2003.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/103105064; *NPTEL Video Lecture on Process control and Instrumentation by Prof. Dr. A.K. Jana, Professor of Chemical engineering, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24CI611X: PROCESS CONTROL** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI611X.1** | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO2** | **U24CI611X.2** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO3** | **U24CI611X.3** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO4** | **U24CI611X.4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO5** | **U24CI611X.5** | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO6** | **U24CI611X.6** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO7** | **U24CI611X.7** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO8** | **U24CI611X.8** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI611X** | | **3** | **2.75** | **2.75** | **2.5** | **3** | **2.125** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |

**3 – HIGH, 2 – MEDIUM, 1 - LOW**

# OPTICAL FIBER COMMUNICATION

| | | | |
|---|---|---|---|
| **Class:** B.Tech. VI –Semester (Exit) | | **Branch:** ECIE | |
| **Course Code:** | **U24CI612X** | **Credits:** | **3** |
| **Hours/Week (L-T-P-O-E):** | **2-0-2-0-4** | **CIE :** | **60%** |
| **Total Number of Teaching Hours:** | **16Hrs** | **ESE :** | **40%** |

**Course Learning Outcomes (COs):**

*After completion of this course, the students should be able to,*

| | |
|---|---|
| *(based on cognitive skills acquired from theory component)* | |
| **CO1 :** | describe the structure, principles, and wave-guiding characteristics of optical fibers |
| **CO2 :** | apply fiber splicing techniques and optical source and detector concepts in optical fiber communication systems |
| **CO3 :** | analyze the performance of optical receivers based on receiver sensitivity and error analysis |
| **CO4 :** | evaluate analog optical link performance and optical network concepts in communication systems |
| *(based on psychomotor skills acquired from laboratory component)* | |
| **CO5:** | determine and characterize the electrical and optical (V-I, P-I) properties of LEDs and Laser diodes and compare their performance as optical sources. |
| **CO6:** | measure key Fiber-optic parameters like numerical aperture, intensity modulation response, and transmission losses in plastic optical fiber |
| **CO7:** | measure the responsivity and characteristics of photodetectors (APD) |
| **CO8:** | test a digital optical communication link, and evaluate its achievable data rate |

**THEORY COMPONENT**

| **UNIT-I** | **4Hrs** |
|---|---|

**Optical Fibers – Structure and Wave Guiding:** Major elements of an optical fiber communication link, nature of light, basic optical laws and definitions, fiber modes and configurations, single-mode and multi-mode fibers, step-index and graded-index fibers

| **UNIT-II** | **4Hrs** |
|---|---|

**Fiber Splicing, Optical Sources and Detectors:** Splicing techniques, optical fiber connectors, connector types and connector return loss, Light Emitting Diode (LED), LASER diode, PIN photodiode and Avalanche Photodiode (APD)

| **UNIT-III** | **4Hrs** |
|---|---|

**Optical Receivers:** Fundamental receiver operation, digital signal transmission, error sources, digital receiver performance, probability of error, receiver sensitivity, quantum limit, eye diagrams, eye pattern features, BER, Q-factor measurements and coherent detection.

| **UNIT-IV** | **4Hrs** |
|---|---|

**Analog Optical Links and Network Concepts:** Carrier-to-noise ratio, carrier power, relative intensity noise (RIN), limiting conditions of RIN, Wavelength Division Multiplexing (WDM), Dense WDM (DWDM), network topology, network categories, network layers, optical layers, SONET and WDM networks

**LABORATORY COMPONENT**

**List of Experiments**

1. Characterization of LED
2. Characterization of Laser diode

3. Intensity modulation of laser output through an optical fiber
4. Measurement of numerical aperture
5. Measurement of losses in plastic fiber
6. Characteristics of APD
7. Optical Power Measurements
8. Measurement of data rate for digital optical link

**Textbook(s):**

1. Gerd Keiser, *Optical Fiber Communications*, Tata McGraw-Hill, New Delhi, 5th ed., 2017.
2. Govind P. Agrawal, *Fiber-Optic Communication Systems*, John Wiley & Sons, 4th ed., 2010.

**Reference Book(S):**

4. John M. Senior, *Optical Fiber Communications - Principles and practice*, Pearson, New Delhi, 3rd ed., 2010
5. P. Chakrabarti, *Optical Fiber Communications*, McGraw Hill, New Delhi, 2015

**Web and Video link(s):**

**https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee142;** *NPTEL Video Lecture on Optical Engineering by Prof. Shanti Bhattacharya, Professor of EEE, IIT Madras*

**Laboratory Manual (for laboratory component):**

*Optical Fiber Communication laboratory manual,* Department of ECIE, KITSW

| **Course Articulation Matrix (CAM):** | | **U24CI612X Optical Fiber Communication** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PSO 1** | **PSO 2** |
| **CO1** | **U24CI612X.1** | 3 | 2 | 1 | 1 | 1 | - | - | - | - | 1 | - | 2 | 2 |
| **CO2** | **U24CI612X.2** | 3 | 2 | 2 | 1 | 1 | - | - | - | 1 | 1 | - | 2 | 2 |
| **CO3** | **U24CI612X.3** | 3 | 3 | 2 | 2 | 1 | - | - | - | 1 | 2 | - | 2 | 2 |
| **CO4** | **U24CI612X.4** | 2 | 2 | 3 | 1 | 1 | 2 | - | - | 1 | 2 | 1 | 2 | 2 |
| **CO5** | **U24CI612X.5** | 3 | 2 | 1 | 3 | 2 | 1 | - | 1 | 2 | 2 | 1 | 2 | 2 |
| **CO6** | **U24CI612X.6** | 3 | 3 | 2 | 3 | 3 | 1 | - | 1 | 2 | 2 | 1 | 2 | 2 |
| **CO7** | **U24CI612X.7** | 3 | 2 | 1 | 3 | 3 | 1 | - | 1 | 2 | 2 | 1 | 2 | 2 |
| **CO8** | **U24CI612X.8** | 2 | 3 | 3 | 3 | 3 | 1 | - | 1 | 3 | 3 | 1 | 2 | 2 |
| **U24CI612X** | | **2.75** | **2.375** | **1.875** | **2.125** | **1.875** | **0.75** | **-** | **0.5** | **1.5** | **1.875** | **0.625** | **2** | **2** |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

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# Semester -VII Syllabi

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | OE | U24OE701 | Open Elective – Sustainable Development Goals Basket (OE-SDGB) | 2 | 1 | - | 3 | 3 |
| 2 | PEC | U24CI702 | Program Elective - II/ MOOCs-II | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI703 | Industrial Automation and Control | 2 | 1 | - | 3 | 3 |
| 4 | PCC | U24CI704 | Biomedical Instrumentation | 2 | 1 | - | 3 | 3 |
| 5 | PCC | U24CI705 | Digital Image Processing and Computer Vision | 2 | 1 | - | 3 | 3 |
| 6 | PCC | U24CI706 | Industrial Automation and Control Laboratory | - | - | 2 | 2 | 1 |
| 7 | PCC | U24CI707 | System Verilog for Verification Laboratory | - | - | 2 | 2 | 1 |
| 8 | ELC | U24CI708 | Internship Evaluation* | - | - | 2 | 2 | 1 |
| 9 | ELC | U24CI709 | Major Project, Phase-1 / Industrial Internship - 1 | - | - | 8 | 8 | 4 |
| **Total:** | | | | **10** | **5** | **14** | **29** | **22** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 4 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 26 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

*@ List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula*

***B. Tech Honours with Research:*** *Students opting for B. Tech Honours with Research, shall complete Research Methodology Course (4 Credits) through MOOCS (OR) a workshop / FDP of not less than one week on "Research Methodologies" (4 Credits).*

*Internship Evaluation for the students opting B. Tech Honours with Research, will be done on the 2-Month Research internship-II.*

| **Open Elective – Sustainable Development Goals Basket (OE-SDGB)** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24OE701A | Sustainable Waste Management and Circular Economy (*offered by CED*) |
| 2. | U24OE701Y | Automotive Engineering for Sustainable Development (*offered by MED*) |
| 3. | U24OE701E | Renewable Energy Systems (*offered by EEED*) |
| 4. | U24OE701I | AI Ethics (*offered by CSMD*) |
| **Program Elective – II Basket / MOOCs-II** | | |
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI702A | RTOS for Embedded Systems |
| 2. | U24CI702B | Industrial Internet of Things |
| 3. | U24CI702C | VLSI Physical Design |
| 4. | U24CI702D | Wireless and Mobile Communications |
| 5. | U24CI702E | *Any other course approved by BoS Chair and Dean AA* |

# SUSTAINABLE WASTE MANAGEMENT AND CIRCULAR ECONOMY

| Class: B. Tech. VII – Semester | | Branch: ECI | |
|---|---|---|---|
| Course Code: | **U24OE701A** | Credits: | **3** |
| Hours/Week (L-T-P-E): | **2-1-0-3** | CIE: | **60%** |
| Total No of Teaching Hours: | **36 Hrs** | ESE: | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** appraise the concept of waste management

**CO2:** analyze activities associated with the management of hazardous wastes

**CO3:** apply the concept of circular economy and conduct relevant research

**CO4:** create business models for sustainable development using complex aspects of circular economy

| **UNIT-I** | **9 Hrs** |
|---|---|

**Waste Management:** Introduction, Context and overview of waste management, Waste landscape in India, Hierarchy of waste management, Sources of waste and waste streams, Challenges and opportunities in waste management

**Strategies for Waste Management:** Need for National Waste Management Strategies (NWMS), Concepts and principles, Objectives, Goals and targets, Policy tools for waste management, Process of developing NWMS, Implementation of NWMS, Roles and responsibilities of various sectors, Supporting initiatives of public and private domains, International recommendations and mandates

| **UNIT-II** | **9 Hrs** |
|---|---|

**Elements of Hazardous Waste Management:** Hazardous waste definition, Sources, Identification and classification, Collection, Handling, Storage and transport, Hazardous waste management rules and regulations, Treatment technologies, Hazardous waste disposal; Hazardous waste landfills- Site selections, Design and operation, Hazardous waste reduction, Recycling and reuse, Remediation of hazardous waste contaminated sites

**Management of different Hazardous waste:** Sources, Production, Collection, Segregation; Treatment and disposal of hazardous wastes- Plastic waste, Biomedical waste, E-waste, Nuclear waste; Global and Indian Context, Hazardous Waste Management Practices– Health and environmental effects, Recycling, Energy production, Landfilling and other applications

| **UNIT-III** | **9 Hrs** |
|---|---|

**Introduction to Circular Economy**: Linear Economy and its emergence, Economic and ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of concept of circular economy, A differential-linear vs Circular economy

**Characteristics of Circular Economy:** Material recovery, Waste reduction, Reducing negative externalities, Explaining butterfly diagram, Concept of loops

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Circular Design, innovation and Assessment**: Zero waste- Waste management in context of circular economy, Circular design, Research and innovation, Life Cycle Assessment (LCA), Circular business models

**Case Studies and Legal Policy Framework** Business models, Solid waste management/Wastewater, Plastics- A case study; EPR- Polluters pay principle, Industrial symbiosis/Eco-parks, Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG

**Textbook(s):**

1. *Guidelines For National Waste Management Strategies: Moving from Challenges to Opportunities*—UNEP-United Nations Institute for Training and Research-2013.
2. John Pichtel, *Waste Management Practices: Municipal, Hazardous and Industrial*, CRC Press, 2nd ed., 2014.
3. Tchobanoglous G, Theisen H and Vigil SA, *Integrated Solid Waste Management, Engineering Principles and Management Issues*, McGraw Hill Education, 2014.

**Reference Book(s):**

1. *National Waste Management Strategy 2020*- Minister of Forestry, Fisheries and the Environment, Republic of South Africa.
2. *Circular Economy: A Credit Point Course*, Proposed by International Council for Circular Economy (ICCE) New Delhi, In Collaboration with All India Council for Technical Education (AICTE) New Delhi.
3. Walter R Stahel Routledge, *The Circular Economy A User's Guide*, 1st ed. (24 June 2019)
4. Shalini Goyal Bhalla, *Circular Economy: (Re) Emerging Movement*, Invincible Publisher.
5. Peter Lacy, Jessica Long, *The Circular Economy Handbook: Realizing the Circular Advantage* Wesley Spindler Palgrave Macmillan UK.
6. Peter Lacy, Jakob Rutqvist, *Waste to Wealth: The Circular Economy Advantage* Palgrave Macmillan

**Web and Video link(s):**

1. https://nptel.ac.in/courses/105105160*; NPTEL Course on Integrated Waste Management for a Smart City (Municipal Solid Waste, C&D Waste, E-Waste, NWMS, Waste Hierarchy, Policy Tools, Composting, Landfilling) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.*
2. https://nptel.ac.in/courses/105105169*; NPTEL Course on Electronic Waste Management – Issues and Challenges (E-Waste Generation, Biomedical, Plastic & Hazardous Waste Rules, Recycling, Landfill Design, Remediation) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.*
3. https://nptel.ac.in/courses/105103205*; NPTEL Course on Municipal Solid Waste Management (Circular Economy Principles, Material Recovery, LCA, Butterfly Diagram, Waste Reduction & Loop Strategies) by IIT Guwahati.*
4. https://onlinecourses.nptel.ac.in/noc25_ce122; *NPTEL Course on Integrated Waste Management for a Smart City – 2025 Edition (Circular Business Models, EPR, Industrial Symbiosis, ESG, Zero-Waste Strategies, India CE Policy Framework) by Prof. Brajesh Kumar Dubey, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | URR24OE701A - SUSTAINABLE WASTE MANAGEMENT AND CIRCULAR ECONOMY | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24OE701A.1 | 2 | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 2 | 1 |
| CO2 | U24OE701A.2 | 2 | 1 | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| CO3 | U24OE701A.3 | 2 | 2 | 2 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| CO4 | U24OE701A.4 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| **U24OE701A** | | **2** | **1.25** | **1.25** | **1** | **2** | **1** | **1** | **1** | **1** | **1** | **1** | **2** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** The student should be able to… | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | appraise the concept of waste management | **SDG 12** | Responsible Consumption and Production | Appraising the waste management hierarchy, National Waste Management Strategies (NWMS), and policy tools for controlling waste streams directly promotes responsible consumption, sustainable production patterns, and significant reduction of waste generation across municipal, industrial, and hazardous waste sectors |
| **CO2** | analyze activities associated with the management of hazardous wastes | **SDG 11** | Sustainable Cities and Communities | Analyzing collection, handling, treatment, landfill design, and regulatory compliance for hazardous wastes — including plastic, biomedical, e-waste, and nuclear waste— safeguards human health and environmental quality, contributing to the development of safe, resilient, and environmentally sustainable urban and industrial communities. |
| **CO3** | apply the concept of circular economy and conduct relevant research | **SDG 9** | Industry, Innovation and Infrastructure | Applying circular economy principles— material recovery, waste reduction, LCA, butterfly diagram, and loop strategies — and conducting innovation-driven research fosters sustainable industrial practices that decouple economic growth from resource depletion, supporting resilient and environmentally responsible industrial infrastructure. |
| **CO4** | Create business models for | **SDG 9** | Industry, Innovation and | Creating circular business models— incorporating EPR, industrial symbiosis, eco-parks, zero-waste strategies, ESG frameworks, |

| | | | | |
|---|---|---|---|---|
| | sustainable development using complex aspects of circular economy | | Infrastructure | and India-specific CE policy goals— drives innovation-led, resource efficient industry and contributes to inclusive, sustainable economic growth aligned with SDG 9 and the global circular economy agenda. |

# AUTOMOTIVE ENGINEERING FOR SUSTAINABLE DEVELOPMENT

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24OE701Y** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** classify automobiles and explain transmission components and supporting sustainable transportation systems

**CO2:** examine the working principle of Steering System, braking system, Suspension System and emission control for sustainability

**CO3:** illustrate hybrid electric vehicles, drivetrains, and energy storage hybridization for sustainable mobility

**CO4:** examine the Energy Storage, and Management Strategies, and current trends in sustainable automobiles

| **UNIT-I** | **9 Hrs** |
|---|---|

**Automobiles:** Introduction, classification and parts; Sustainable Vehicle Structure- chassis layout and frames

**Transmission system:** Requirements, types and elements

**Clutch**-Function, types- friction clutches - single plate, multi-plate, centrifugal and semi-centrifugal; automatic transmission device- fluid flywheel

**Gear box:** Types-sliding mesh, constant mesh, synchromesh and automatic gear box

| **UNIT-II** | **9 Hrs** |
|---|---|

**Steering system:** Principle, need, layout, steering gear, steering ratio, steering lock, turning radius, Power steering- hydraulic and electronic

**Braking system:** Classification, principle, requirements; types- disc, hydraulic, power and servo; automatic and antilock braking system

**Suspension system:** Functions, elements, torsion bars, stabilizer bars and shock absorbers; types- rigid axle, solid leaf spring and coil spring, air suspension

**Emissions and Control:** Effects of emissions, Sustainable pollution control, Euro norms, Bharat norms; testing devices, vehicle standard service and maintenance

| **UNIT-III** | **9 Hrs** |
|---|---|

**Sustainable Hybrid Electric Vehicles:** History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies; Hybrid Electric Drive-Trains: Basic concept of hybrid traction, Sustainable power flow control in hybrid drive-train topologies.

**Hybrid Electric Drive-Trains**: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, fuel efficiency analysis.

**Hybridization:** Introduction to hybridization of different energy storage devices, Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Sustainable Energy Storage:** Energy Storage Requirements in Hybrid and Electric Vehicles, Sustainable Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis

**Energy Management Strategies:** Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies

**Current Trends in Sustainable Automobiles:** Autonomous, artificial intelligence and machine

learning, electric vehicle, hybrid electric vehicle and solar vehicle

**Textbook(s):**

1. Srinivasan. S, *Automotive Mechanics*, 2nd ed., Tata McGraw-Hill, 2003. (*Chapters 1 to 6,9,19,20 &26*)
2. C. Mi, M. A. Masrur and D. W. Gao, *Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives*, John Wiley & Sons, 2011. (*Chapters 1, 4 &5*)
3. S. Onori, L. Serrao and G. Rizzoni, *Hybrid Electric Vehicles: Energy Management Strategies*, Springer, 2015. (*Chapters 3*)

**Reference Book(s):**

1. Dr. Kirpal Singh, *Automobile Engineering*, Vol. I & II, 14th ed., Standard Publishers, NewDelhi, 2017.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design*, CRC Press, 2004.
3. R. K. Rajput, *Automobile Engineering*, 2nd ed., Laxmi Publishers, 2017.
4. Kamaraju Ramakrishna, *Automobile Engineering*, 1st ed., PHI Learning, New Delhi, 2016.
5. William H.Crouse and Donald L. Anglin, *Automotive Mechanics*, 10th ed., Tata McGraw-Hill, 2006.
6. Joseph Heitner, *Automotive Mechanics Principles and Practices*, 2nd ed., CBS Publishers & Distributors Pvt. Ltd, 2004.
7. K M Gupta, *Automobile Engineering*, Vol. I & II, Delhi, Umesh Publications, 2002.

**Web and Video link(s):**

1. https://elearn.nptel.ac.in/shop/nptel/fundamentals-of-automotive-systems; *NPTEL Video Lecture on Automobile Engineering by Professor C. S. Shankar Ram, IIT Madras.*
2. https://nptel.ac.in/courses/108106170; *NPTEL Video Lecture on Fundamentals of Electric vehicles: Technology & Economics, Professor of Electrical Engineering, IIT Madras.*
3. https://nptel.ac.in/courses/108103009*; Web notes on Introduction to Hybrid and Electric Vehicles by Prof. S. Majhi&Prof. Praveen Kumar,Professor ofElectronics and Electrical Engineering, IIT Guwahati.*

| **Course Articulation Matrix (CAM):** | | **U24OE701Y - AUTOMOTIVE ENGINEERING FOR SUSTAINABLE DEVELOPMENT** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24OE701Y.1** | 2 | 1 | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| **CO2** | **U24OE701Y.2** | 2 | 1 | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| **CO3** | **U24OE701Y.3** | 2 | 1 | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| **CO4** | **U24OE701Y.4** | 2 | 1 | 1 | - | - | 1 | - | 1 | - | - | 1 | 1 | 1 |
| **U24OE701Y** | | **2** | **1** | **1** | **-** | **-** | **1** | **-** | **1** | **-** | **-** | **1** | **1** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | Classify automobiles and explain transmission components and supporting sustainable transportation systems | **SDG 9** | Build resilient infrastructure, promote sustainable industrialization and foster innovation. | Understanding transmission systems enhances knowledge of efficient automotive design components, sustainable transportation technologies, and innovative drivetrain solutions for reliable and sustainable mobility |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO2** | examine the working principle of Steering System, braking system, Suspension System and emission control for sustainability | **SDG 11** | Efficient vehicle systems for safer and more sustainable. And support cleaner urban environments. | Efficient steering, braking, and power transmission systems improve vehicle performance and reduce energy losses. Knowledge of these systems supports the design of fuel-efficient and energy-optimized automobiles, contributing to sustainable transportation and efficient energy utilization. |
| **CO3** | Illustrate hybrid electric vehicles, drivetrains, and energy storage hybridization for sustainable mobility. | **SDG 12** | Ensure sustainable consumption and production patterns. | Studying types of hybrid electric vehicle and its types of components. Knowledge on working principle of hybrid vehicle. Understanding hybrid electric vehicles, advanced drivetrains, and energy storage technologies supports clean energy adoption, sustainable transportation, resource efficiency, and climate action, thereby. |
| **CO4** | examine the Energy Storage, and Management Strategies, and current trends in sustainable automobiles. | **SDG 7** | Promotes efficient energy storage and utilization technologies that support clean and sustainable energy use in transportation. | understanding modern storage technologies and energy management systems, emerging trends in the automotive industry. Knowledge of these technologies enables the development of energy-efficient, environmentally sustainable, and innovative transportation solutions. Effective energy storage and management reduce energy consumption, improve vehicle performance, |

# RENEWABLE ENERGY SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24OE701E** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **40%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **60%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** evaluate the sources of renewable and conventional energy resources, quantify solar power and judge the applicability of solar energy

**CO2:** analyze the wind power developed by a wind energy system and the operational difficulties associated with geothermal energy

**CO3:** analyze the feasibility of harnessing of electric power from oceans and biomass

**CO4:** select an appropriate energy storage system for a given application and summarize the operating principle of fuel cell

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction**: Conventional and non-conventional sources of energy – brief description of different renewable energy sources

**Solar energy**: Introduction to prospects of solar PV systems: photovoltaic effect and electrical equivalent circuit of a PV cell, dependence of a PV cell characteristic on temperature, solar cell output characteristics, solar maximum power point tracking (MPPT) using Perturb &Observe algorithm, applications of solar PV systems- street lighting, domestic lighting, solar PV pumping systems

| **UNIT-II** | **9 Hrs** |
|---|---|

**Wind energy**: Principles of wind power, evaluation of wind intensity, operation of a wind turbine and wind power curve, different types of wind turbine generators, topography and classification of wind turbines and its applications

**Geothermal Energy**: Origin and types of geothermal energy, operational difficulties, liquid dominated systems

| **UNIT-III** | **9 Hrs** |
|---|---|

**Energy from Oceans**: Ocean temperature differences, ocean waves, energy from the waves, introduction of tidal power, basic principle of tidal power, components of tidal power plants

**Bioenergy**: Introduction, bio-mass conversion technologies, photo synthesis, biogas generation, biogas from power plant wastes, methods of maintaining biogas production, utilization of biogas, biogas gasification

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Chemical energy sources**: Introduction to fuel cells, principle of operation of fuel cell, classification of fuel cells, advantages, disadvantages and applications of fuel cells

**Types of energy storage systems**: Introduction, mechanical energy storage systems, batteries, ultra-capacitors, super conducting magnetic storage, applications

**Textbook(s):**

1. Rai G.D, *Non-Conventional Energy Sources*, 4th ed. New Delhi: Khanna Publishers, 2010.

**Reference Book(s):**

1. B.H. Khan, *Non-conventional Energy Resources*, 2nd ed. New Delhi: McGraw Hill Education (India) Pvt. Ltd., 2006.
2. Felix A. Farret, M. Godoy Simoes, *Integration of Alternative Sources of Energy*, New Jersey: John Wiley & Sons, 2006.
3. Bansal N. K,Kaleeman, M.Miller, *Renewable Energy Sources and Conversion Technology*, New Delhi: Tata McGraw Hill Education (India) Pvt. Ltd., 2006.

4. Duffie and Beckman, *Solar Energy Thermal Process*, New Jersey: John Wiley & Sons, 2006.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc25_ch40;

| Course Articulation Matrix (CAM): | | U24OE701E - RENEWABLE ENERGY SYSTEMS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24OE701E.1 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO2 | U24OE701E.2 | 3 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 3 |
| CO3 | U24OE701E.3 | 3 | 2 | 2 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| CO4 | U24OE701E.4 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 2 | 3 | 2 |
| **U24OE701E** | | **3** | **2.5** | **2** | **1** | **1.75** | **2.25** | **1** | **1** | **1** | **1** | **2** | **2.75** | **2.5** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement –** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | evaluate the sources of renewable and conventional energy resources, quantify solar power and judge the applicability of solar energy | **SDG7** | Affordable and Clean Energy | Smart grid concepts promote efficient, reliable, and sustainable electrical energy systems through intelligent monitoring, automation, and integration of clean energy resources. |
| **CO2** | analyze the wind power developed by a wind energy system and the operational difficulties associated with geothermal energy | **SDG9** | Industry, Innovation and Infrastructure | Smart grid computational tools, optimization methods, artificial intelligence, and automation technologies support innovation and modernization of power infrastructure. |
| **CO3** | analyze the feasibility of harnessing of electric power from oceans and biomass | **SDG13** | Climate Action | Distributed generation technologies such as renewable energy systems, microgrids, electric vehicles, and storage technologies contribute to reduction of greenhouse gas emissions and support climate-resilient energy systems. |
| **CO4** | select an appropriate energy storage system for a given application and summarize the operating principle of fuel cell | **SDG11** | Sustainable Cities and Communities | Smart communication technologies, PMUs, WAMS, and intelligent control systems improve reliability, efficiency, and sustainability of urban power distribution systems and smart city infrastructure. |

# AI ETHICS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. | | **Branch:** ECI | |
| **Course Code:** | **U24OE701I** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply the fundamental concepts of artificial intelligence to explain key ethical issues, approaches, & the significance of AI ethics in modern society

**CO2:** analyze ethical issues in AI through the perspectives of policy, regulation, philosophy of technology, & real-world case studies

**CO3:** apply ethical frameworks & methods in applied ethics to identify, interpret, & evaluate ethical challenges arising from AI systems

**CO4:** analyze human values, intelligence, & human nature in the context of AI systems, & assess the boundaries between humans & intelligent machines

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** What is Artificial Intelligence, Why AI Ethics is so exciting?, Bottom-up and Top-down approaches to AI Ethics, The boundaries and limitations of ethics, Developing ethical autonomy

**The Rise of AI Ethics:** Ethical questions in AI currently receiving attention, Same or different?, What's special about AI Ethics?, Common themes and varieties of questions in AI Ethics, Ethical questions in AI currently receiving attention

| **UNIT-II** | **9 Hrs** |
|---|---|

**AI Policy and Regulatory Standards:** AI Ethics, Law, Policy, Regulation, Ethics guidance Case study-An indigenous AI report

**AI, Philosophy of Technology, and Ethics:** Comparing AI to humans, Case study-Attributing agency to humans and to AI, A brief introduction to the philosophy of technology, Technology and attitudes towards nature, The implicit values of technology, Communication through new technologies

| **UNIT-III** | **9 Hrs** |
|---|---|

**Methods in Applied Ethics:** A simple account of methods in Applied Ethics, The challenges from AI for methodology in Applied Ethics, Common assumptions about the nature of ethics and their influence on methodology in Applied Ethics

**Methodology in Applied Ethics:** The stories we tell, Introduction to ethical narratives in AI, Stories about AI systems

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Humans and Intelligent Machines – Underlying Values:** The nature and value of intelligence, Values underlying the use of data

**Human Nature:** Self, Reason, Boundaries; Philosophical perspectives - The Divided Self and notions of the Higher Self, Reason or Emotion?, The boundaries of Human nature, Boundaries and limits, Is human nature Perfectible?, Myths and origin stories about human nature

**Textbook(s):**

1. P. Boddington, *AI Ethics*, 1st ed., Cham, Switzerland: Springer International Publishing, 2017. (*Chapters 1 to 5*)

**Reference Book(s):**

1. P. Boddington, *Artificial Intelligence: Foundations, Theory, and Algorithms*, Cham, Switzerland: Springer Nature, 2023.

2. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., Hoboken, NJ, USA: Pearson, 2021.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_cs132; *NPTEL Video Lecture on Responsible & Safe AI Systems by Prof. Ponnurangam Kumaraguru, IIIT Hyderabad and Prof. Balaraman Ravindran & Prof. Arun Rajkumar, IIT Madras*

| **Course Articulation Matrix (CAM):** | | **U24OE701I - AI ETHICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24701I.1** | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 2 | 2 | 1 |
| **CO2** | **U24701I.2** | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | - | 2 | 2 | 1 |
| **CO3** | **U24701I.3** | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | - | 2 | 2 | 1 |
| **CO4** | **U24701I.4** | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | - | 2 | 2 | 1 |
| **U24701I** | | **2** | **2** | **2.5** | **2.25** | **1** | **1** | **1** | **1** | **1** | **-** | **2** | **2** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 – LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply the fundamental concepts of artificial intelligence to explain key ethical issues, approaches, & the significance of AI ethics in modern society | **SDG4** | Quality Education | AI ethics improves critical thinking and awareness about responsible technology use, strengthening quality education and informed learning in emerging technologies. |
| **CO2** | analyze ethical issues in AI through the perspectives of policy, regulation, philosophy of technology, & real-world case studies | **SDG16** | Peace, Justice and Strong Institutions | Studying AI governance, law, and policy supports ethical decision-making, transparency, and responsible institutional frameworks for trustworthy AI systems. |
| **CO3** | apply ethical frameworks & methods in applied ethics to identify, interpret, & evaluate ethical challenges arising from AI systems | **SDG9** | Industry, Innovation and Infrastructure | Ethical analysis methods help design safer and more responsible AI systems, promoting innovation with accountability in technological development. |
| **CO4** | analyze human values, intelligence, & human nature in the context of AI systems, & assess the boundaries between humans & intelligent machines | **SDG3** | Good Health and Well-being | Understanding human-centered AI and value alignment supports safer AI applications in healthcare, psychology, and human well-being systems. |

# RTOS FOR EMBEDDED SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI702A** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

- **CO1:** interpret task life cycle, and scheduling policies using FreeRTOS
- **CO2:** design inter-task communication systems using queues and software timers
- **CO3:** utilize semaphores, mutexes, and event groups for task synchronisation
- **CO4:** develop memory-efficient embedded applications with proper interrupt handling using FreeRTOS advanced features

| **UNIT-I** | **9 Hrs** |
|---|---|

**FreeRTOS**: RTOS fundamentals, Hard vs soft real-time, FreeRTOS architecture and configuration (FreeRTOSConfig.h), xTaskCreate(), Task handle, Task parameters, Task priorities, Ready list, Scheduling algorithm, Task states and state machine, vTaskDelay() and vTaskDelayUntil(), Idle task and idle task hook, vTaskDelete() and task lifecycle, Scheduling policies: cooperative and preemptive

**Applications:** Multi-task LED blink, Task state demo applications

| **UNIT-II** | **9 Hrs** |
|---|---|

**Queues:** Queue creation and data passing between tasks, Blocking sends and receives, Queue sets, xQueueSendFromISR / xQueueReceiveFromISR, Sending structures & mailbox concept

**Software Timers:** Software timer concepts, Daemon task, xTimerCreate() and callback functions, One-shot and auto-reload timers, Timer management API: Start/Stop/Reset/ChangePeriod; Timer ISR API and pvTimerGetTimerID(),

**Applications:** Queue producer-consumer & software timer debounce applications

| **UNIT-III** | **9 Hrs** |
|---|---|

**Binary and Counting Semaphores:** Binary semaphore creation and Give/Take, ISR deferral with semaphores (GiveFromISR), Counting semaphores: creation and use cases; Mutexes: creation, ownership, and recursion, Priority inversion and priority inheritance, Recursive mutexes (TakeRecursive/GiveRecursive), Gatekeeper task pattern,

**Event groups**: creation, SetBits, WaitBits; xEventGroupSync() barrier, SetBitsFromISR,

**Applications:** Priority inversion demo & event group sync

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Memory Management:** Heap models: heap_1 to heap_5 comparison; pvPortMalloc/ vPortFree, Heap monitoring APIs, Stack overflow detection and configuration,

**Interrupt management:** Interrupt nesting model and priority rules, FromISR APIs and portYIELD_FROM_ISR(), Deferred interrupt processing patterns

**Task notifications**: All API variants, Stream buffers and message buffers, Run-time stats, tickless idle, trace tools

**Applications:** UART task notification driver & memory profiling applications

**Textbook(s):**


1. Richard Barry, *Mastering the FreeRTOS Real Time Kernel*, Real Time Engineers Ltd., 2016.


**Reference Book(s):**


1. Jean J. Labrosse, *MicroC/OS-III: The Real-Time Kernel*, Micrium Press, 2011.
2. Qing Li, Caroline Yao, *Real-Time Concepts for Embedded Systems*, CMP Books, 2003.
3. David E. Simon, *An Embedded Software Primer*, Addison-Wesley, 1999.


**Web and Video link(s):**

1. http://nptel.ac.in/courses/108105057; *NPTEL Video Lectures on Embedded Systems, IIT*

| **Course Articulation Matrix (CAM):** | | **U24CI702A: RTOS FOR EMBEDDED SYSTEMS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI702A.1** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| **CO2** | **U24CI702A.2** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| **CO3** | **U24CI702A.3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| **CO4** | **U24CI702A.4** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 3 | 3 | 3 |
| **U24CI702A** | | **2** | **3** | **3** | **3** | **3** | **3** | **3** | **2** | **2** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | interpret task life cycle, and scheduling policies using FreeRTOS | **SDG9** | Industry, Innovation and Infrastructure | Understanding real-time task scheduling and life cycle management enables design of time-critical industrial control systems and automation infrastructure that underpin smart manufacturing and Industry 4.0 ecosystems. |
| **CO2** | design inter-task communication systems using queues and software timers | **SDG11** | Sustainable Cities and Communities | Designing reliable inter-task communication with queues and timers directly enables responsive embedded systems in smart city infrastructure — including traffic management, environmental monitoring, and public safety networks — contributing to sustainable and connected urban communities. |
| **CO3** | utilize semaphores, mutexes, and event groups for task synchronisation | **SDG3** | Good Health and Well-being | RTOS-based synchronisation primitives are foundational to safety-critical medical devices such as infusion pumps, patient monitors, and wearable health sensors, where race conditions and priority inversion could have life-threatening consequences — directly supporting reliable healthcare delivery. |
| **CO4** | develop memory-efficient embedded applications with proper interrupt handling using FreeRTOS advanced features | **SDG4** | Quality Education | Mastering advanced RTOS features — memory management, interrupt service routines, and tickless idle — builds deep embedded systems competency that prepares students for professional engineering roles, fostering high-quality technical education aligned with industry needs. |

# INDUSTRIAL INTERNET OF THINGS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI702B** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** analyze the challenges & recent developments in industrial internet of things technologies

**CO2:** examine the automation networks trends and security issues related to industrial internet of things

**CO3:** identify the hardware components & functions of PLC systems and develop ladder diagram programs for PLC using logical functions

**CO4:** choose required communication bus standards for industrial applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Industrial Internet of Things (IIoT):** Introduction to IIoT, Challenges in industrial networks, Future trends in industrial networks, Recent developments in industrial networks for industry 4.0, Industrial automation protocols, Interaction with IoT ecosystem, Summary of current wireless IIoT technologies, Ultra-Reliable Low-Latency Communication (URLLC) for IIoT applications

| **UNIT-II** | **9 Hrs** |
|---|---|

**Automation Trends in IIoT:** Industrial revolutions, Enabling technologies for new productive model, Automation networks in smart industries – Automation pyramid, Information and operational technologies convergence and distribution, Reference Architecture for IIoT and factories digitalization

**Security in IIoT:** Cloud models, Cloud computing security, IoT security, IIoT security issues and challenges

| **UNIT-III** | **9 Hrs** |
|---|---|

**Programmable Logic Controllers (PLC**): Introduction, Parts of PLC, Principle of operation, PLCs Vs PC, PLC sizes, PLC hardware components – I/O section, Discrete and analog modules, I/O specifications, CPU, Memory design, Terminal devices, Human machine interfaces (HMIs)

**Basics of PLC programming:** Data files, Program files, PLC scan process, PLC programming languages, Bit level instructions, Instruction addressing, Branch instructions, Internal relay instructions, If open and if close examination, Entering ladder diagrams, Modes of operation

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Process Control, Network Systems and SCADA(Qualitative):** Types of processes, Structure of control systems, On/Off control, PID control, Motion control, Data communications – Serial communication, Bus standards: DeviceNet, ControlNet, EtherNet/IP, Field bus, Profibus, HART, Major elements of a SCADA system, Alarm handling in SCADA systems

**Textbook(s):**


1. Ismail Butun, *Industrial IoT: Challenges, Design Principles, Applications, and Security*, Switzerland: Springer Nature, 2020. (*Chapters 1 to 5*)
2. Frank D. Petruzella, *Programmable logic controllers*, 5th ed. New York: McGraw Hill education. (*Chapters 1,2,4,5 and 14*)


**Reference Book(s):**

1. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, California: Apress Media, 2016.
2. Surekha Bhanot, *Process Control: Principles and Applications*, 6th ed., New Delhi: Oxford University Press, 2011.
3. K Padma Raju, Y. J. Reddy, *Instrumentation and control systems*, McGraw Hill Education, India, 2017.
4. Boyer SA, *Supervisory Control and Data Acquisition (SCADA)*, Pittsburgh: International Society of Automation Press, 2004.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/106105195; *NPTEL Video Lecture on Introduction to Industry 4.0 and Industrial Internet of Things by Prof. Sudeep Misra, Professor of CSE, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI702B: Industrial Internet of Things (IIoT) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI702B.1 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO2 | U24CI702B.2 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO3 | U24CI702B.3 | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO4 | U24CI702B.4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI702B** | | **3** | **2.8** | **2.8** | **2** | **3** | **1.3** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

**CO–SDG Alignment Matrix**

| CO | CO Statement *The student should be able to…* | Relevant SDG | SDG Description | Mapping Justification |
|---|---|---|---|---|
| CO1 | analyze the challenges & recent developments in industrial internet of things technologies | SDG9 | Industry, Innovation and Infrastructure | Analyzing challenges and recent developments in Industrial Internet of Things (IIoT) technologies supports the development of smart industries, advanced industrial infrastructure, and innovative automation solutions, thereby contributing to sustainable industrial growth. |
| CO2 | examine the automation networks trends and security issues related to industrial internet of things | SDG3 | Good Health and Well-being | Examining automation network trends and security issues in IIoT enhances the reliability, safety, and secure operation of industrial and healthcare-related systems, thereby supporting human well-being and safe industrial environments. |
| CO3 | identify the hardware components & functions of PLC systems and develop ladder diagram programs for PLC using logical functions | SDG11 | Sustainable Cities and Communities | Identifying PLC hardware components and developing ladder logic programs help in building intelligent automation systems for smart industries and urban infrastructure, contributing to sustainable cities and communities. |
| CO4 | choose required communication bus standards for industrial applications | SDG9 | Industry, Innovation and Infrastructure | Selecting appropriate industrial communication bus standards improves efficient data exchange, interoperability, and reliability in industrial automation systems, thereby supporting industrial innovation and modern infrastructure development. |

# VLSI PHYSICAL DESIGN

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI702C** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply partitioning algorithms such as Kernighan-Lin, Fiduccia-Mattheyses, and multilevel partitioning techniques to optimize netlist decomposition

**CO2:** utilize floor planning and placement strategies using sequence pair, constraint graph, simulated annealing, and placement algorithms to achieve optimized chip area

**CO3:** develop graph-based algorithms for efficient global & detailed routing solutions and apply channel routing techniques in congestion-aware VLSI interconnect design

**CO4:** apply timing closure methodologies using static timing analysis, zero-slack optimization, timing-driven placement/routing and physical synthesis techniques

| **UNIT-I** | **9 Hrs** |
|---|---|

**Netlist and System partitioning:** VLSI design flow, Introduction and terminology, Optimization goals, Partitioning algorithms, Kernighan-Lin (KL) algorithm, Extensions of KL algorithm, Fiduccia-Mattheyses (FM) algorithm, Framework for multilevel partitioning, Clustering, Multilevel partitioning

| **UNIT-II** | **9 Hrs** |
|---|---|

**Floor Planning and Placement:** Introduction to floorplanning, Optimization goals in floorplanning, Floorplan representations, Constraint graph pair, Sequence pair techniques, Floorplanning algorithms, Floorplan sizing, Cluster growth, Simulated annealing, Integrated floorplanning algorithms, Pin assignment, Power and ground routing, Global placement, Min-cut placement

| **UNIT-III** | **9 Hrs** |
|---|---|

**Routing Techniques:** Global routing, Routing regions representation, Global routing flow, Single-net routing, Rectilinear routing, Connectivity graph routing, Dijkstra's algorithm, Full-netlist Routing, Integer linear programming, Rip-up and reroute, Detailed routing, Horizontal and vertical constraint graphs

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Timing Closure:** Timing Analysis and Performance Constraints, Static Timing Analysis, Zero-Slack Algorithm, Timing-Driven Placement, Timing-Driven Routing, Physical Synthesis, Gate Sizing, Buffering, Netlist Restructuring, Performance-Driven Design Flow.

**Textbook(s):**


1. Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu, *VLSI Physical Design: From Graph Partitioning to Timing Closure*, 1st ed., New York: Springer Science & Business Media, 2011. *(Chapters 2, 3, 4, 5, 6 and 8)*
2. Sadiq M. Sait, Habib Youssef, *VLSI Physical Design Automation: Theory and Practice*, Vol. 6, Singapore: World Scientific, 1999. *(Chapters 1, 2 and 3)*


**Reference Book(s):**


1. Naveed A. Sherwani, *Algorithms for VLSI Physical Design Automation*, 3rd ed., New York: Springer Publications, 1999.
2. Khosrow Golshan, *Physical Design Essentials: An ASIC Design Implementation Perspective*, 1st ed., New York: Springer Publications, 2007.
3. Sung Kyu Lim, *Practical Problems in VLSI Physical Design Automation*, 1st ed., New York: Springer Publications, 2008.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc21_cs12; *NPTEL Video lecture on VLSI Physical Design by Prof. Indranil Sengupta, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI702C: VLSI PHYSICAL DESIGN | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI702C.1 | 1 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| CO2 | U24CI702C.2 | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| CO3 | U24CI702C.3 | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | U24CI702C.4 | 2 | 2 | 2 | 3 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| U24CI702C | | 1.75 | 2 | 2 | 1.75 | 1.75 | - | - | 1 | 1 | 1.75 | 2 | 2 | 2 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply partitioning algorithms such as Kernighan-Lin, Fiduccia-Mattheyses, and multilevel partitioning techniques to optimize netlist decomposition | **SDG9** | Industry, Innovation and Infrastructure | Applying partitioning algorithms such as Kernighan-Lin, Fiduccia-Mattheyses and multilevel methods improves scalable chip architecture design, supports semiconductor innovation, and strengthens efficient electronic infrastructure development. |
| **CO2** | analyze floorplanning and placement strategies using sequence pair, constraint graph, simulated annealing, and placement algorithms to achieve optimized chip area | **SDG4** | Quality Education | Analyzing floorplanning and placement strategies provides practical knowledge in chip area optimization, interconnect planning, and CAD-based design methodologies, thereby enhancing quality technical education in VLSI physical design. |
| **CO3** | develop efficient global and detailed routing solutions using graph-based algorithms channel routing techniques for congestion-aware VLSI interconnect design | **SDG8** | Decent work and Economic Growth | Developing congestion-aware global and detailed routing solutions builds industry-relevant skills in interconnect optimization, EDA tool usage, and chip implementation, thereby improving employability and supporting economic growth. |
| **CO4** | apply timing closure methodologies using static timing analysis, zero-slack optimization, timing-driven placement/routing, and physical synthesis techniques | **SDG9** | Industry, Innovation and Infrastructure | Applying timing closure techniques such as static timing analysis, zero-slack optimization, and physical synthesis enables high-performance reliable IC design, promoting advanced semiconductor innovation and robust digital infrastructure. |

# WIRELESS AND MOBILE COMMUNICATIONS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI702D** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** explain various mobile radio propagation models and the fading effects on the system performance

**CO2:** model the wireless channel in terms of large scale/small scale fading, delay spread, coherence time parameters

**CO3:** understand the basic concepts of Cellular System, the design requirements and CDMA technology

**CO4:** analyze the effectiveness of diversity techniques to mitigate the multichannel fading effects on received signals with insights on MIMO technology, channel capacity analysis, and UWB performance

| **UNIT-I** | **9 Hrs** |
|---|---|

**Wireless Communications and Diversity**: Fast fading wireless channel modelling, Rayleigh/Ricean fading Channels, BER Performance in fading channels, Diversity modeling for wireless communications, BER performance improvement with diversity, Types of diversity – Frequency, Time, Space

| **UNIT-II** | **9 Hrs** |
|---|---|

**Broadband Wireless Channel Modelling:** WSSUS Channel modelling, RMS delay spread, Doppler fading, Jakes model, Autocorrelation, Jakes spectrum, Impact of doppler fading

| **UNIT-III** | **9 Hrs** |
|---|---|

**Cellular Communications:** Introduction to cellular communications, Frequency reuse, Multiple access technologies; Cellular processes - Call setup, Handover etc.,

**CDMA:** Introduction to CDMA, Walsh codes, Variable tree OVSF, PN Sequences, Multipath diversity, RAKE receiver, CDMA receiver synchronization

| **UNIT-IV** | **9 Hrs** |
|---|---|

**MIMO:** Introduction to MIMO, MIMO channel capacity, MIMO spatial multiplexing, MIMO diversity, OFDM

**UWB (Ultrawide Band):** UWB Definition and features, UWB Wireless channels, UWB Data modulation, Uniform pulse train, Bit-Error rate performance of UWB

**Textbook(s):**


1. T.S. Rappaport, *Wireless Communications – Principles and Practice*, 2nd ed., Pearson, 2010
2. Jochen Schiller, *Mobile Communication*, 2nd ed., Pearson Education, 2003.


**Reference Book(s):**


1. D. Tse and P. Vishwanath, *Fundamentals of Wireless Communications*, 2nd ed., Cambridge Univ Press, 2005.
2. A. Goldsmith, *Wireless Communications*, 2nd ed., Cambridge Univ Press, 2005.
3. Ezio Biglieri, *MIMO Wireless Communications*, 1st ed., Cambridge University Press, 2007.


**Web and Video link(s):**

1. https://nptel.ac.in/courses/106106167; *NPTEL Video lecture on Introduction to Wireless and Cellular Communications by Prof. David Koilpillai, Dept. of ECE, IIT Madras.*

| Course Articulation Matrix (CAM): | | U24CI702D: Wireless and Mobile Communications | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI702D.1 | 2 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| CO2 | U24CI702D.2 | 2 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| CO3 | U24CI702D.3 | 2 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| CO4 | U24CI702D .4 | 2 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| **U24CI702D** | | **2** | **2** | **1** | **2** | **-** | **-** | **1** | **1** | **1** | **1** | **-** | **2** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | Gain insights into various mobile radio propagation models and the fading effects on the system performance | **SDG9** | Industry, Innovation and Infrastructure | Understanding radio propagation and fading phenomena enables the design of reliable wireless communication networks, which are essential components of modern digital infrastructure and technological innovation. |
| **CO2** | Model the wireless channel in terms of large scale/small scale fading, delay spread, coherence time parameters | **SDG9** | Industry, Innovation and Infrastructure | Wireless channel modelling helps engineers optimize network planning, improve communication reliability, and enhance the performance of broadband wireless systems, thereby strengthening communication infrastructure. |
| **CO3** | Understand the basic concepts of Cellular System, the design requirements and CDMA technology | **SDG11** | Sustainable Cities and Communities | Cellular communication technologies provide seamless connectivity for smart cities, emergency communication, transportation systems, and public services, contributing to sustainable urban development. |
| **CO4** | analyze the effectiveness of diversity techniques to mitigate the multichannel fading effects on received signals with insights on MIMO technology, channel capacity analysis, and UWB performance. | **SDG9** | Industry, Innovation and Infrastructure | Advanced wireless technologies such as MIMO, diversity techniques, and UWB improve spectral efficiency, network capacity, and communication quality, supporting next-generation communication systems and technological innovation. |

# INDUSTRIAL AUTOMATION AND CONTROL

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI703** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** identify building blocks of automation control system and apply discontinuous controller modes of operation for process control applications

**CO2:** apply continuous controller modes of operation for process control and estimate the controller tuning parameters using one-quarter decay ratio, C-C & Z-N techniques

**CO3:** utilize multiple loop/ advanced control configurations for different process control applications

**CO4:** utilize automated control configurations (PLC, SCADA & DCS) for different process control applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** Introduction to Industrial automation, Evolution & necessity, Automation pyramid - Field level, Control level, Supervisory level, Planning level, Management level

**Open-Loop vs Closed-Loop Systems**: Review of Open-loop and Closed-loop systems Characteristics, Industrial examples - Manual valve control vs Automated flow control using a transmitter

**Discontinuous Controller Modes:** Control system parameters - Controller output, Controller range and control lag; Controller response of discontinuous controllers – Position controllers (ON-OFF & Multi-position) and Floating controllers (Single speed & Multi-speed)

| **UNIT-II** | **9 Hrs** |
|---|---|

**Continuous Controller Modes**: Terminology- Proportional Band, Offset, Reset time, Derivative time, Controller response of continuous controllers – Proportional (P), Integral (I), Derivative (D), PI, PD & PID; Controller transfer function and frequency response of continuous controllers (P, PI, PD & PID)

**Controller Tuning Methods:** Simple performance, Time integral performance, One quarter decay ratio, Cohen-Coon, Ziegler-Nicohls

| **UNIT-III** | **9 Hrs** |
|---|---|

**Multiple-loop Control Configurations (Block diagram approach):** Cascade control, Selective control, Split range control, Feed forward control (FFC), Ratio control, Feed forward & feedback control (FFFBC)

**Advanced Control Configurations (Block diagram approach):** Programmed adaptive control, Self adaptive control, Inferential control, Multi-variable control

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Supervisory Control and Data Acquisition (SCADA) System:** Architecture, RTUs, MTUs, Data logging, Alarms management, HMI (Human Machine Interface), Real-time trend analysis

**Programmable Logic Controller (PLC)**: Hardware architecture, Timers, Counters, Math instructions, Ladder logic programming, Data handling, Interfacing HMI with PLC

**Distributed Control System (DCS):** System architecture, Sub-systems, Local field station, Communication options in DCS, Simatic PCS 7 Controller

**Textbook(s):**

3. G. Stephanopoulos, *Chemical Process Control*, 6th ed., PHI, 1998. (*Chapters 5, 10, 11, 13, 14, 16, 18, 20 to 23*)

4. Surekha Bhanot, *Process Control: Principles and Applications*, 6th ed., Oxford University Press, 2011. (*Chapters 1 to 6, 8, 10 to 12*)

**Reference Book(s):**

4. C.D. Johnson, *Process Control Instrumentation Technology*, 4th ed., PHI, 1996
5. D.R. Coughanowr, *Process Systems Analysis and Control*, 3rd ed., McGraw Hill, New York, 2009.
6. B.G. Liptak, *Instrument Engineers Hand Book, Vol.III*, 4th ed., Chilton book co., Philadelphia, 2003.

**Web and Video link(s):**

2. https://nptel.ac.in/courses/103105064; *NPTEL Video Lecture on Process control and Instrumentation by Prof. Dr. A.K. Jana, Professor of Chemical engineering, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24CI703: Industrial Automation and Control** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI703.1** | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO2** | **U24CI703.2** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO3** | **U24CI703.3** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO4** | **U24CI703.4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI703** | | **3** | **2.8** | **2.8** | **2** | **3** | **1.3** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO 1** | analyze the architecture and functional levels of industrial automation | **SDG9** | Industry, Innovation and Infrastructure | Understanding industrial automation architecture and functional levels helps in developing modern industrial infrastructure, smart manufacturing systems, and innovative automation solutions, thereby supporting sustainable industrial growth and technological advancement. |
| **CO 2** | apply continuous controller modes of operation for process control and estimate the controller tuning parameters using one-quarter decay ratio, C-C & Z-N techniques | **SDG3** | Good Health and Well-being | Applying process controllers and tuning techniques improves the accuracy, reliability, and safety of industrial processes such as chemical, pharmaceutical, and healthcare systems, contributing to efficient operations and better health and well-being. |
| **CO 3** | utilize multiple loop/ advanced control configurations for different process control applications | **SDG11** | Sustainable Cities and Communities | Advanced and multiple-loop control configurations improve efficiency, safety, and sustainability in industrial and urban process systems such as water treatment, energy management, and smart city infrastructure, supporting sustainable communities. |
| **CO 4** | utilize automated control configurations (PLC, SCADA & DCS) for different process control applications | **SDG9** | Industry, Innovation and Infrastructure | Utilizing PLC, SCADA, and DCS-based automated control systems enhances industrial productivity, process reliability, and technological innovation, thereby strengthening modern industrial infrastructure and automation practices. |

# BIOMEDICAL INSTRUMENTATION

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI704** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** identify physiological systems & bioelectric signal acquisition methods

**CO2 :** utilize measurement techniques for cardiovascular system

**CO3:** utilize measurement techniques for respiratory & neuromuscular systems and identify safety considerations for patient monitoring

**CO4:** analyze ECG signals for detection of arrythmia using signal processing & machine learning techniques and MRI & CT-Scan images for detection of tumours using deep learning technique

| **UNIT-I** | **9 Hrs** |
|---|---|

**Fundamentals of Biomedical Systems:** Introduction to Biomedical Instrumentation, Man–Instrument system, Components and functional block diagram; Physiological systems overview, Problems in measuring living systems; Bioelectric potentials- Resting and action potentials, Propagation of action potentials; Biopotential electrodes- Fundamentals, Surface electrodes, Microelectrodes, Biochemical transducers (Basic working principle)

| **UNIT-II** | **9 Hrs** |
|---|---|

**Cardiovascular Measurements:** Cardiovascular system overview- Generation and lead systems, ECG waveform, Basic interpretation; Blood pressure measurement: Direct and indirect methods; Blood flow measurement- Electromagnetic and Ultrasonic methods; Cardiac output measurement, Plethysmography, Pacemakers, Defibrillators

| **UNIT-III** | **9 Hrs** |
|---|---|

**Respiratory and Neuro-muscular System: P**hysiology of the respiratory system, Measurement of respiration- Spirometry, Airflow; Somatic nervous system- EEG waveforms, EEG Machine, EEG Sleep stages; EMG Machine (Basic working principle, Applications)

**Patient Monitoring & Safety:** ICU Monitoring- Basics, Parameters, Block diagram; Electrical safety- Physiological effects, Micro shock, Macro shock, Protection methods

| **UNIT-IV** | **9 Hrs** |
|---|---|

**ECG Signal Processing:** Characteristics of biomedical signals, Noise and artifacts, Filtering and artifact removal, Waveform analysis- Morphological analysis, Envelope detection, Feature extraction techniques; ECG Signal Analysis- QRS detection, Classification of arrhythmia, Machine learning Machine learning based ECG feature extraction

**Medical Imaging (Basic principle and Applications):** Ultrasonic measurement, X-ray, CT–scan, MRI scan, Machine learning based medical imaging application: CNN-based tumour detection

**Textbook(s):**


1. Cromwell, L. and Weibell, F.J. and Pfeiffer, E.A., *Biomedical Instrumentation and Measurement*, 2nd ed. Dorling Kingsley, London, 2006. (*Chapters: 1, 3, 4, 5, 6, 7, 14*)
2. S. Ananthi, *A Textbook of Medical Instruments*, New Age International (P) Ltd., New Delhi, 2005. (*Chapters: 8,9,10,11*)

**Reference Book(s):**


1. Khandpur, R.S., *Handbook of Biomedical Instrumentation*, 2nd ed., McGraw Hill, 2003.
2. Webster, J.G., *Medical Instrumentation Application and Design*, 3rd ed. John Wiley, 2007.
3. Maria Deprez & Emma C. Robinson, *Artificial Intelligence in Healthcare*, Academic Press, London, 2020.


**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc22_ee116; *NPTEL Lecture on Biomedical Instrumentation, by Prof. Varadhan SKM, Dept. of Applied Mechanics and Biomedical Engg., IIT Madras*

| **Course Articulation Matrix (CAM):** | | **U24CI704: BIOMEDICAL INSTRUMENTATION** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI704.1** | 3 | 1 | – | – | 1 | 2 | 1 | – | – | – | 2 | 2 | 2 |
| **CO2** | **U24CI704.2** | 3 | 3 | 2 | 1 | 2 | 2 | – | 1 | – | – | 2 | 2 | 2 |
| **CO3** | **U24CI704.3** | 3 | 3 | 2 | 3 | 2 | 2 | 2 | – | 1 | – | 2 | 2 | 2 |
| **CO4** | **U24CI704.4** | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 |
| **U24CI704** | | **3.00** | **2.5** | **1.75** | **1.75** | **1.75** | **2** | **1.25** | **1.67** | **1** | **2** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify physiological systems & bioelectric signal acquisition methods | **SDG3** | Good Health and Well-being | Biomedical measurement + AI diagnosis directly supports healthcare improvement |
| **CO2** | utilize measurement techniques for cardiovascular system | **SDG4** | Good Health and Well-being | Biomedical measurement + AI diagnosis directly supports healthcare improvement |
| **CO3** | utilize measurement techniques for respiratory & neuromuscular systems and identify safety considerations for patient monitoring | **SDG9** | Industry, Innovation & Infrastructure | ML/DL healthcare applications foster innovation and smart healthcare infrastructure |
| **CO4** | analyze ECG signals for detection of arrythmia using signal processing & machine learning techniques and MRI & CT-Scan images for detection of tumor using deep learning technique | **SDG9** | Industry, Innovation & Infrastructure | ML/DL healthcare applications foster innovation and smart healthcare infrastructure |

# DIGITAL IMAGE PROCESSING AND COMPUTER VISION

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI705** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply the image pre-processing techniques such as sampling, quantization, various intensity transformation & filtering techniques to enhance the input image clarity

**CO2 :** identify the effect of frequency domain filters, image restoration & reconstruction techniques and apply the same for smoothing, sharpening & image enhancement

**CO3:** apply morphological image processing techniques on objects present in the input images to extract image components & discover various ways to segment the objects

**CO4:** extract the features to depict the shape of an object and apply classification techniques to identify the object present in an input image

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** What is digital image processing? Examples of fields that use digital image processing, Fundamental steps in digital image processing

**Digital Image Fundamentals:** Elements of visual perception, Light and the electromagnetic spectrum, Image sensing and acquisition, Image sampling and quantization, Basic relationships between pixels, Introduction to the mathematical tools used in digital image processing

**Intensity Transformations & Spatial Filtering:** Basics of intensity transformations and spatial filtering, Basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods

| **UNIT-II** | **9 Hrs** |
|---|---|

**Filtering in Frequency Domain:** A brief history of the Fourier series and transform, Preliminary concepts, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, Properties of the 2-D discrete Fourier transform, Basics of filtering in frequency domain

**Image Restoration and Reconstruction:** A model of the image degradation/restoration process, Noise models, Restoration in the presence of noise only-spatial filtering, Periodic noise reduction using frequency domain filtering

| **UNIT-III** | **9 Hrs** |
|---|---|

**Morphological Image Processing:** Preliminaries, Erosion and dilation, Opening and closing, Hit-or-miss transformation, Basic morphological algorithms

**Image Segmentation:** Fundamentals, Point, Line and edge detection**,** Thresholding, Segmentation by region growing and by region splitting and merging, Region segmentation using clustering and super pixels, Segmentation using morphological watersheds

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Feature Extraction:** Background, Boundary preprocessing, Boundary feature descriptors, Region feature descriptors, Principal components as feature descriptors, Whole-image features, Scale-invariant feature transform

**Image Pattern Classification:** Background, Patterns and pattern classes, Pattern classification by prototype matching, Optimum (Bayes) statistical classifiers, Neural networks and deep learning, Deep convolution neural networks

**Textbook(s):**

1. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Pearson, 4th ed., 2018, New

York. *(Chapters 1 to 3, 9 to 12)*

**Reference Book(s):**


1. Anil K. Jain, *Fundamentals of Image Processing*, Pearson, 1st ed., Chennai, 2015.
2. B. Chanda, D. Dutta Majunder, *Digital Image Processing and Analysis*, PHI, New Delhi, 2nd ed., 2011.
3. S. Sridhar, *Digital Image Processing*, Oxford University Press, 2nd ed., Noida, 2016.
4. Munesh C. Trivedi, *Digital Image Processing*, Khanna Book Publishing, 1st ed., New Delhi 2014.


**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc22_ee116; *NPTEL Video Lecture on Dital Image Processing by Prof. Prabir Kumar Biaswas, Professor of EEE, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24CI705: DIGITAL IMAGE PROCESSING AND COMPUTER VISION** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI705.1** | 1 | 2 | 2 | 1 | - | - | 1 | - | 1 | - | - | 2 | 2 |
| **CO2** | **U24CI705.2** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| **CO3** | **U24CI705.3** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| **CO4** | **U24C705.4** | 2 | 2 | 3 | 3 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| **U24CI705** | | **1.75** | **2** | **2.25** | **1.75** | **-** | **-** | **1** | **-** | **1** | **-** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply the image pre-processing techniques such as sampling, quantization, various intensity transformation & filtering techniques to enhance the input image clarity | **SDG3** | Good Health and Well-being | Image pre-processing enhances medical images (MRI, CT, X-ray) by reducing noise and improving contrast, enabling accurate diagnosis and early disease detection. |
| **CO2** | identify the effect of frequency domain filters, image restoration & reconstruction techniques and apply the same for smoothing, sharpening & image enhancement | **SDG9** | Industry, Innovation and Infrastructure | Frequency domain filtering and restoration techniques improve image quality in industrial and satellite imaging systems, supporting reliable infrastructure monitoring and innovation. |
| **CO3** | apply morphological image processing techniques on objects present in the input images to extract image components & discover various ways to segment the objects | **SDG11** | Sustainable Cities and Communities | Image segmentation and morphological analysis enable applications like traffic analysis, surveillance, and urban monitoring, contributing to safer and smarter cities. |
| **CO4** | extract the features to depict the shape of an object and apply classification techniques to identify the object present in an input image | **SDG9** | Industry, Innovation and Infrastructure | Feature extraction and classification form the backbone of AI-driven systems such as autonomous vehicles, industrial automation, and smart analytics, fostering technological innovation. |

# INDUSTRIAL AUTOMATION AND CONTROL LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI706** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** simulate single loop & multiple loop controllers using SIMULINK software

**CO2:** examine the performance of ON-OFF, P, PI & PID controllers for single loop process control systems like temperature, pressure, level & flow controllers

**CO3:** examine the performance of ON-OFF, P, PI & PID controllers for multiple loop control configurations like cascade & split control configurations

**CO4:** develop ladder diagram programs for PLC and examine the performance of DCS

**LIST OF EXPERIMENTS**

9. Simulation and Analysis of open loop and closed loop systems using SIMULINK
10. Process Dynamics with and without Transport Delay using SIMULINK
11. Tuning of controllers using SIMULINK
12. Simulation and Analysis of Feed forward feedback control Systems using SIMULINK
13. Simulation and Analysis of Cascade control Systems using SIMULINK
14. Response analysis of Level process using ON-OFF, P, PI, PD & PID controller modes
15. Response analysis of Flow process using ON-OFF, P, PI, PD & PID controller modes
16. Response analysis of Pressure process using ON-OFF, P, PI, PD & PID controller modes
17. Response analysis of level process using split range control configuration
18. Response analysis of level-flow integrated process using cascade control configuration
19. Implementation of ladder logic for logical functions, traffic control & other industrial applications using PLC
20. Configuration of Siemens SIMATIC PCS 7 Environment for industrial applications

**Textbook(s):**

1. G. Stephanopoulos, *Chemical Process Control*, 6th ed., PHI, 1998. (*Chapters 5, 10, 11, 13, 14, 16, 18, 20 to 23*)

**Reference Book(s):**

1. C.D. Johnson, *Process Control Instrumentation Technology*, 4th ed., PHI, 1996
2. D.R. Coughanowr, *Process Systems Analysis and Control*, 3rd ed., McGraw Hill, New York, 2009.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/103105064; *NPTEL Video Lecture on Process control and Instrumentation by Prof. Dr. A.K. Jana, Professor of Chemical engineering, IIT Kharagpur.*

**Laboratory Manual:**

1. Manual for *Industrial Automation and Control Laboratory* prepared by faculty of Department of ECIE, KITSW.

| Course Articulation Matrix (CAM): | | U24CI706: Industrial Automation and Control Laboratory | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI706.1 | 3 | 2 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO2 | U24CI706.2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO3 | U24CI706.3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| CO4 | U24CI706.4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI706** | | **3** | **2.8** | **2.8** | **3** | **3** | **3** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | simulate single loop & multiple loop controllers using SIMULINK software | **SDG3** | Good Health and Well-being | Advanced and multiple-loop control configurations improve efficiency, safety, and sustainability in industrial and urban process systems such as water treatment, energy management, and smart city infrastructure, supporting sustainable communities. |
| **CO2** | examine the performance of ON-OFF, P, PI & PID controllers for single loop process control systems like temperature, pressure, level & flow controllers | **SDG9** | Industry, Innovation and Infrastructure | Applying process controllers and tuning techniques improves the accuracy, reliability, and safety of industrial processes such as chemical, pharmaceutical, and healthcare systems, contributing to efficient operations and better health and well-being. |
| **CO3** | examine the performance of ON-OFF, P, PI & PID controllers for multiple loop control configurations like cascade & split control configurations | **SDG11** | Sustainable Cities and Communities | Understanding multiple-loop control configurations such as cascade and split-range control improves industrial process efficiency, reliability, and automation practices, contributing to modern industrial infrastructure and innovation. |
| **CO4** | develop ladder diagram programs for PLC and examine the performance of DCS | **SDG 13** | Climate Action | developing PLC ladder logic programs and analyzing DCS performance enables efficient industrial automation and energy-optimized process operation, which supports sustainable industrial practices and climate action initiatives. |

# SYSTEM VERILOG FOR VERIFICATION LABORATORY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI707** | **Credits:** | **1** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** apply System Verilog constructs to design and verify logic circuits such as Priority Encoder, Multiplexers & flip-flops using suitable testbenches

**CO2:** design and verify sequential circuits & memory modules such as binary counters, single-port RAM, dual-port RAM using System Verilog

**CO3:** design memory & error-detection circuits such as Content Addressable Memory (CAM), parity checker, single-port RAM verification modules using System Verilog with efficient transaction-based verification methodologies

**CO4:** develop verification components such as monitor, driver, and scoreboard for single-port RAM using System Verilog to ensure functional correctness

**LIST OF EXPERIMENTS**

1. Design and verification of a Priority Encoder using System Verilog
2. Design and verification of Multiplexers using System Verilog
3. Design and verification of Flip-flops and Latches using System Verilog
4. Design and verification of a Binary Counter with load using System Verilog
5. Design Single Port RAM Asynchronous Read/Write using System Verilog
6. Design Dual Port RAM Asynchronous Read/Write using System Verilog
7. Design Content Addressable Memory (CAM) using System Verilog
8. Design Bit Parity Checker using System Verilog
9. Verification of simple Single Port RAM: Transaction Generator program using System Verilog
10. Verification of simple Single Port RAM: Monitors program using System Verilog
11. Verification of simple Single Port RAM: Driver program using System Verilog
12. Verification of simple Single Port RAM: Scoreboard program using System Verilog

**Textbook(s):**


1. Chris Spear, *System Verilog for Verification – A guide to learning the Test bench language features*, 2nd ed., New York: Springer Publications, 2010. *(Chapters 3, 5, 6 and 9)*
2. Stuart Sutherland, Simon Davidmann, Peter Flake, *System Verilog for Design- A guide to using system Verilog for Hardware design and modelling*, 2nd ed., New York: Springer Publications, 2006. *(Chapters 1-5)*


**Reference Book(s):**


1. Janick Bergeron, *Writing Testbenches using SystemVerilog*, 1st ed., New York: Springer Publications, 2006.
2. Doulos, *SystemVerilog Golden Reference Guide: A concise guide to SystemVerilog*, Version 5.0, Ringwood: Doulos, 2010.
3. Sasan Iman, *Step-by-Step Functional Verification with SystemVerilog and OVM*, 1st ed., Seattle: Hansen Brown Publishing Company, 2008.
4. Janick Bergeron, Eduard Cerny, Alan Hunter, Andrew Nightingale, *Verification Methodology Manual for SystemVerilog*, 1st ed., New York: Springer Publications, 2005.


**Web and Video link(s):**

1. www.asic-world.com/systemverilog/index.html; *Tutorials, examples, links, tools and books related to System Verilog*

**Laboratory Manual:**

1. Manual for *System Verilog for Verification Laboratory* prepared by faculty of Department of ECIE, KITSW.

| Course Articulation Matrix (CAM): | | U24CI707: SYSTEM VERILOG FOR VERIFICATION LABORATORY | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI707.1 | 1 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | 2 | 2 | 2 |
| CO2 | U24CI707.2 | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| CO3 | U24CI707.3 | 2 | 2 | 2 | 2 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| CO4 | U24CI707.4 | 2 | 2 | 2 | 3 | 2 | - | - | 1 | 1 | 2 | 2 | 2 | 2 |
| **U24CI707** | | **1.75** | **1.75** | **2** | **2** | **1.75** | **-** | **-** | **1** | **1** | **1.75** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | apply System Verilog constructs to design and verify logic circuits such as Priority Encoder, Multiplexers & flip-flops using suitable testbenches | **SDG9** | Industry, Innovation and Infrastructure | Designing and verifying priority encoders, multiplexers and flip-flops using SystemVerilog develops digital design skills required for semiconductor industries and strengthens innovation-oriented hardware infrastructure development. |
| **CO2** | design and verify sequential circuits & memory modules such as binary counters, single-port RAM, dual-port RAM using System Verilog | **SDG4** | Quality Education | Designing counters and RAM modules using SystemVerilog provides hands-on learning in sequential logic and memory system design, improving practical competencies and quality technical education in VLSI design. |
| **CO3** | design memory & error-detection circuits such as Content Addressable Memory (CAM), parity checker, single-port RAM verification modules using System Verilog with efficient transaction-based verification methodologies | **SDG8** | Decent work and Economic Growth | Developing CAM, parity checker and transaction-based RAM verification skills prepares students for verification and semiconductor job roles, enhancing employability and supporting growth of the electronics industry. |
| **CO4** | develop verification components such as monitor, driver, and scoreboard for single-port RAM using System Verilog to ensure functional correctness | **SDG9** | Industry, Innovation and Infrastructure | Developing monitor, driver and scoreboard components for RAM verification builds advanced verification expertise essential for reliable chip design, promoting innovation and robust digital infrastructure. |

# INTERNSHIP EVALUATION

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | U24CI708 | **Credits:** | **6** |
| **Hours/Week (L-T-P- E):** | **0-0-2-2** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE:** | **-** |

**Course Learning Outcomes (COs)**:

*After completion of this course, the students should be able to,*

**CO1:** **d**emonstrate understanding of professional practices, workplace ethics, **&** organizational functioning through internship experience

**CO2:** **a**pply engineering knowledge **&** modern tools to perform assigned tasks and solve real-world problems

**CO3:** **e**xhibit professional skills including communication, teamwork, leadership, and lifelong learning

**CO4:** **p**repare internship reports **&** effectively communicate internship outcomes through presentations **&** viva-voce

**Mandatory Internships**:

1. The internships provide exposure to the real-world, get a feel for the work environment and how a professional workplace operates.
2. During the internship, students will experience a real-life engineering workplace and understand how their engineering and professional knowledge, skills, and qualities (KSQs) can be utilized in industry.
3. Students can learn, more importantly, how to apply the KSQs they have acquired during an internship to their future workplaces.
4. Students will also be able to demonstrate functioning engineering knowledge, both new & existing, and identify areas of further development for their future careers.
5. Internships give the student an opportunity to bridge theory and practice
6. Internships also provide students with the soft skills needed at workplace and leadership positions.
7. The internship guidelines are governed by the rules stipulated in the Institute's Internship Policy-2020 document.
8. The students shall have to undergo 6-8 weeks of mandatory internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs, IIITs& NITs.
9. HoD, along with Prof i/c internships, shall address students (*of 2nd, 4th and 6th semesters*) during last week of even semester of every academic year on the following

a. creating awareness on mandatory 6-8 weeks internship by every student
b. creating awareness on COs of internships
c. KSQs the students would acquire doing internships
d. expected internship outcomes
e. available internship options, and organizations offering internships
f. progressively completing 6-8 weeks internship by the end of 6th semester summer, starting from 2nd semester summer break.
g. internship evaluation in 7th semester
h. internship report submission and oral presentation (through PPT) by student

10. Students undergoing the internship shall be required to submit their details to the department internship coordinators of the respective branches. He will coordinate all the internship activities of the students of that department.

11. Students have to submit a signed undertaking to the department internship coordinator for demonstrating honesty, integrity, professionalism and regular attendance at work place to add value to the organization where the internship is allotted. Students also have to uphold the professional image of our institute.
12. In case, a student is found to violate the internship rules and regulations, the student will have to produce a valid reason for the violation of internship rules. Without a valid reason, the student will be debarred from taking part in subsequent placement activities of the institute.
13. The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of one week internship at every stage.
14. The internship evaluation shall be done in the VII semester of study and hence the students shall complete the prescribed period of internship before start of VII semester (from end of II semester to commencement of VII semester).
15. The student learning assessment process (SLAP): The SLAP in internships shall include feedback from internship supervisor, submission of internship report on the complete internship and PPT presentation.
16. Internship Log Book: The activity journaling in a log book is very important for a successful internship.
    a. The internship supervisor identifies the work goals at the beginning of the internship
    b. Student has to maintain internship log book, where in the activities undertaken during internship and timely submission at periodic intervals are to be documented.
    c. At the conclusion of the internship, the supervisor shall specifically comment, in the internship log book, on whether the student met each of the work goals and to give evidence which describes the quality of work. For student, this also serves as a self- assessment.
    d. Internship log book *(with due signatures of the internship supervisor)* shall be considered for evaluation during presentation, i.e., number of planned meetings with internship supervisor and number attended by student
17. Meeting Cadence:
    i. **Regular meetings with internship supervisor:** Regular meetings with the internship supervisor to discuss work goals and review the status of activities undertaken are very essential. Student shall participate in discussions and take notes.
    ii. **Meeting Frequency:** The meeting cadence, *i.e., meeting frequency* shall be fixed in consultation with the internship supervisor and accordingly student has to participate in discussions and take notes. Take signatures of internship supervisor as per the planned cadence in the internship log book.
18. The internship evaluation shall be done by ***department internship evaluation committee*** **(DIEC)** based on the submitted report by student and oral presentation.
19. There shall be only Continuous Internal Evaluation (CIE) for internship evaluation.
20. CIE for the Internship evaluation in VII semester shall be as below:

| Internship evaluation | Weightage |
|---|---|
| A. **Internship Supervisor's Assessment**<br>(i) Feedback from the internship supervisor<br>- *on completion of internship assignment/work (20%)*<br>(ii) Feedback from the internship supervisor<br>- *on quality of work in internship assignment/work (10%)*<br>(iii) Feedback from the internship supervisor<br>- *internship log book (10%)*<br>(iv) Feedback from the internship supervisor | **50%** |

| | |
|---|---|
| - *on attendance, punctuality and work hours (10%)*<br><br>*(For the case of 6-8 week internship done in more than one spell, it will be the average of all the internship supervisors' assessments)* | |
| **B. DIEC Assessment**<br>(i) **Internship duration** (8 /12 weeks) (6/8 weeks online via NPTEL and 2/4 weeks offline) (**10%** / 10%)<br>**(ii) Internship Report (20%)**<br>**(iii) Oral Presentation** *(with PPT)* **and viva voce (10%)**<br>**(iv) SDG Alignment (5%)**<br>**(v) Research Orientation (5%)** | **50%** |
| **Total Weightage:** | **100%** |

**Note:** *It is mandatory for the student to appear for oral presentation (with PPT) and viva voce to qualify for course evaluation*

**(a) Internship Report:** Each student is required to submit a well-documented internship report (both *soft copy and softbound hard copy*) as per format specified by DIEC. In case of completing the 6-8 weeks internship in more than one organization, the student shall be required to prepare separate softbound internship reports signed by the internship supervisor (s)along with the seal(s) of the organization(s). The student shall submit two final softbound internship reports along with a soft copy, keeping all the certificate(s) issued by the internship supervisor(s) and all the individual internship reports cleared by the respective internship supervisor. Chapter 1 of the final internship report shall clearly describe the following, indicating an overall summary.

(i) **Internship(s) attended**: A table with name & address of organization, organization's vision and mission, internship weeks attended, internship period (exact dates attended), internship supervisor, head of the section and head of the organization.

(ii) **Duties/tasksduring internship(s)**: Table describing name&address of organization, and the duties/tasks undertaken during internships. This indicates what opportunities and learning experiences the interns got to get hands-on experience on a wide range of KSQs of a professional engineer.

(iii) **Tangible outcomes of internship:** These are the lessons learnt from internship experience. The students have to describe in their own words what they learnt from the internship experience. The student has to describe what specific KSQs are acquired by him, with reference to the expected internship COs, after successful completion of internship(s). Finally, a table depicting systematic mapping of what they have learnt and the expected internship COs is to be shown.

(iv) Student feedback on internship: To gather information on whether the internship was useful and gave practical experience in the chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*)with closed and open questions shall be kept in the report.

(v) Pictures at the worksite: Student has to keep, in the report, his working pictures at the worksite, discussing with the internship supervisor, the creative project he is working on, or an event he is attending for work, group photo of the team/section/department he worked with.

**(b) Anti-Plagiarism Check:** The internship report should clear the plagiarism check as per the Anti-Plagiarism policy-2020 of the institute.

**(c) Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the DIEC as per the schedule notified by the department. The presentation shall compulsorily have slides on the points mentioned in (a)(i)-(v)

**(d)** It is mandatory for every student to *appear for oral presentation(with PPT) and viva-voce*, to qualify for internship evaluation

**(e)** A student shall register for supplementary examination for the internship evaluation in the following cases:

(i) absent for oral presentation and viva-voce

(ii) fails to submit the internship report in prescribed format

(iii) fails to fulfill the requirements of internship evaluation as per specified guidelines

**(f)** Supplementary examination for internship evaluation

(i) The CoE shall send the list of students registered for supplementary examination to the HoD concerned.

(ii) The DIEC, duly constituted by the HoD, shall conduct the internship evaluation supplementary exam and send the award list to the CoE within the stipulated time.

| **Course Articulation Matrix (CAM):** | | **U24CI708: INTERNSHIP EVALUATION** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | U24CI708.1 | 1 | - | - | - | - | - | 1 | 3 | - | - | - | - | - |
| **CO2** | U24CI708.2 | 3 | 2 | 1 | 1 | 3 | - | 1 | - | - | - | - | 2 | 2 |
| **CO3** | U24CI708.3 | - | - | - | - | - | - | 1 | 1 | 3 | 3 | 2 | - | - |
| **CO4** | U24CI708.4 | - | - | - | - | - | - | 1 | - | 1 | 3 | - | - | - |
| **U24CI708** | | **2** | **2** | **1** | **1** | **3** | **-** | **1** | **2** | **2** | **3** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | demonstrate understanding of professional practices, workplace ethics, & organizational functioning through internship experience | **SDG 4** | Quality Education | Industrial internship provides experiential learning in ECI domains such as Embedded Systems, IoT, VLSI, Communication Systems, Signal Processing, Artificial Intelligence, and Semiconductor Technologies. Students acquire practical skills, industry exposure, professional networking opportunities, and lifelong learning abilities, thereby strengthening quality technical education and employability. |
| **CO2** | apply engineering knowledge & modern tools to perform assigned tasks and solve real-world problems | **SDG 11** | Sustainable Cities and Communities | Effective communication and collaboration are essential for multidisciplinary ECI projects such as smart city infrastructure, intelligent transportation systems, public safety networks, and digital communication platforms that contribute to sustainable and connected communities. |
| **CO3** | exhibit professional skills including communication, teamwork, leadership, & lifelong learning | **SDG 9** | Industry, Innovation and Infrastructure | Application of ECI concepts to industrial problems through communication networks, embedded systems, IoT, VLSI, robotics, AI-enabled systems, and automation technologies promotes innovation, industrial modernization, and sustainable infrastructure development. |
| **CO4** | prepare internship reports | **SDG 12** | Responsible | Professional ethics, quality |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| | & effectively communicate internship outcomes through presentations & viva-voce | | Consumption and Production | assurance, responsible technology deployment, resource optimization, and sustainable engineering practices in ECI industries encourage responsible production, efficient use of resources, and continuous improvement. |

# MAJOR PROJECT PHASE-I

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI709** | **Credits:** | **4** |
| **Hours/Week (L-T-P- E):** | **0-0-8-8** | **CIE:** | **100%** |
| **Total Number of Teaching Hours:** | **-** | **ESE:** | |

**Course Learning Outcomes (COs)**:

*After completion of this course, the students should be able to,*

**CO1:** review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (**Technical skills**)

**CO2:** design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (**Problem solving and critical thinking skills**)

**CO3:** apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (**Ethics and teamwork**)

**CO4:** collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (**Communication skills and life-long learning**)

1. Final Year Major Project work represents the culmination of study towards the B. Tech degree. ***Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems***. The **student learning assessment process** (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project work.
2. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
3. **Team work:** Major project work is a team work.
   (i) The students of a project team shall work together to achieve a common objective.
   (ii) Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of a team having knowledge diversity, gender diversity, social and cultural diversity among its members.
4. **Two phases:** Major project work shall be carried out in two phases. Nearly 50 - 75% of the proposed work to be completed in 7$^{th}$semester as *Phase-I* and the remaining work to be continued and completed in 8$^{th}$semester as *Phase-II.*
5. Every student is expected to put approximately **72 hours of work**intothemajorproject *phase-I* courseoverthe12weeksof7$^{th}$semester.
6. **Majorprojectwork *Phase-I*: 7$^{th}$semester**
   (i) The HoD shall constitute the ***Department Major Project Evaluation Committee (DMAJPEC)*** with the following composition:

| *Department Major Project Evaluation Committee (DMAJPEC)* | |
|---|---|
| HoD | Chairman |
| Senior Faculty | Convener |
| Coordinator(s) | Section-wise coordinator(s)<br>*One coordinator for each section* |
| Three Faculty members | Section-wise faculty members<br>*Three faculty members for each section representing various specializations. (Five specializations will be covered including the coordinator's and Convener's)* |

(ii) Major project allotment to students during last working week of 6thsemester:

(a) **First / Second week of 6thSemester**: The process shall be initiated during the first / second week of 6thsemester by collecting project titles from the department faculty research groups, on offering innovative ideas/solutions for engineering problems.

(b) **MSE-I period of 6th Semester – Notifying project titles**: The finalizedproject titles shall be notified to students during the MSE-I period of 6th semester and student teams shall be allowed to exercise their options on titles that interest them.

(c) **Last working week of 6th Semester – Allotment of titles and supervisors to project teams**: The project title allotment to major project teams shall be completed before the last day of instruction of 6th semester

*(d)* **6th semester summer break - Literature review**: This 6th semester schedule enables students to complete literature review, preliminary simulations / investigations / experimentation during 6th semester summer break and *start the work from day-one in 7thsemester*

(e) **Registration Presentation - Notifying the tentative dates:** The major projectteams are expected to give registration presentation during second / third week from the commencement of 7th semester. The tentative dates for conducting the registration presentation shall be notified at the time of releasing the circular on allotted project title and project supervisors, as indicated in (c) above. This enables student teams to plan the work accordingly during summer break, to complete the literature review, preliminary simulations / investigations and get ready for informative, confident and comfortable presentations on their project work.

(iii) The convener DPEC shall notify, during MSE-I period of 6th semester, the list of implementable project titles offered by the faculty of different research groups of the department

(a) Project titles shall come with the following details to be made available to students on dept webpage and notice boards, facilitating students to select problems that interest them.

i. abstract
ii. deliverables / outcomes
iii. knowledge and skills required to complete the project
iv. resources required
v. one of the deliverables shall be writing a technical paper out of the major project work done for submission to a reputed non-predatory conference/non-paid peer reviewed journal

(iv) The major project teams, finalized by the convener DPEC, shall be allowed to exercise their options on the titles that interest them from the notified list

(v) **Project supervisor allotment**: The convener DPEC shall allot, during the last week of 6th semester, the faculty supervisors to all project teams

(a) The project supervisors shall

i. **define project objectives and expected deliverables**

**ii. help the students plan their project work and timeline**

**iii. provide enough resources for successful project completion**

(vi) The faculty supervisors are expected to provide guidance to project teams on

(a) *Knowledge, skills and qualities (KSQ) to be acquired* to propose solutions to the identified real-world problems

(b) *Problem analysis* - to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

*(c) Applying engineering knowledge* - to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

(d) *Design/development of solutions* - to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental Considerations

(e) *Conduct investigations of complex problems* - to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

(f) *Modern tool usage* – to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

(g) *The Engineering and the world* – to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

(h) *Ethics* – to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice

(i) *Individual and team work* – to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

(j) *Communication* – to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

(k) *Project management and finance* – to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

(l) *Life-long learning* – to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

(vii) The project supervisors are also expected to continuously emphasize and guide students on

**(a) Meeting Cadence:**

i. **Regular meetings with supervisor:** Short and frequent meetings increase a team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.

ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week.** Due weightage will be given to meeting cadence and considered for evaluation during presentations, i.e., number of planned meetings and number attended by students

(b) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).

ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-I*, the supervisor shall specifically comment, in the project log book, on whether the project team met each of the project work *phase-I* goals and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(c) **Following project timeline**: completing the tasks as planned in project timeline

(d) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, which can be specially acquired by participating in major project work

(e) **Writing down whatever is done and making notes of whatever is read.** Writing down the procedures/models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, ***difficulties faced and how they were fixed*** are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well- documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on.

This information will be needed for the bibliography in your project report. On the other hand, documenting a report ***on the spur of the moment*** would end up copying things from other sources resulting in a plagiarized document.

(f) **Good and sufficient literature review**: Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

(g) Completing nearly 50 - 75% of the proposed work during phase-I

(h) Right conduct of research to promote academic integrity, honesty and time management

(i) Preparing a well-documented report in proper format, covering the progress made during Phase-I

(j) Consequences of plagiarism and use of anti-plagiarism software to detect plagiarism in documents

(k) Submission of major project phase-I report within acceptable plagiarism levels, as per the ***Anti-plagiarism policy-2020 of our institute***.

*(l)* **Video pitch:** Capturing short videos, photos, screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the work done during *phase-I*.

(m) **Project Paper**: Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained, and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.

(n) **Project poster**: At the end of phase-II, the project teams shall have to presenttheir project in the form of posters, at the time of demonstration of complete porotype / working model / software package / system developed.

(viii) Phase **– I evaluation**: There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components

(a) **Registration Presentation** *(during second / third week of 7th semester):* The Registration Presentation shall include a brief report and presentation focusing the identified problem, objective(s), literature review, identifying research gap in the literature, implementation of existing methods, proposed solution, and expected outcome(s).

i. The registration presentation shall invariably include the **project plan timeline** with actual start and finish dates– monthly/weekly project milestones/ timeline prepared in MS Excel or any other project management tool.

ii. **Project timeline** – *Weekly project milestones*: It's a compact and creative way to present a project plan. Identify the project intermediate goals and related tasks for completing each of those goals. Categorize tasks for each week. In the project timeline use different colors to the tasks for each week. Horizontal timeline layouts shall be preferred or any other layout of team's choice.

iii. Project teams shall create and present the following during registration presentation

1. *Complete project timeline*
2. *Phase-I project timeline*
3. *Phase-II project timeline*

iv. During every presentation, project teams shall compulsorily show the following as part of their presentation

1. *The slides on project timeline and*
2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*

v. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*) during presentations

(b) **Progress Presentation-I** *(during penultimate week of 7th semester):* At the end of first stage (7th semester), student teams shall be required present, before the DPEC, the progress made during phase-I and submit a well-documented report of work done for evaluation to the project coordinator

i. **Following project timeline**: The project timeline shall be meticulously followed and the tasks shall be completed as planned in the project timeline.

*ii.* Project teams shall compulsorily show the following as part of their *progress presentation-I*

1. *The slides on project timeline and*
2. *A table showing targeted tasks as per timeline and whether tasks are accomplished?*

iii. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (*with due signatures of project supervisor*)

(c) **CIE schedule**: The convener DPEC shall release the complete schedule of CIE before start of 7th semester well in advance, so that student teams will complete the scheduled works and get ready with an informative, confident, and comfortable presentation for registration and progress presentations.

(ix) CIE for the Major project work Phase-I shall be as given below:

| **Major project work Phase-I Assessment** *(7th semester)* | **Weightage** |
|---|---|
| **A. Supervisor Assessment** | **20%** |
| **B. DMAJPEC Assessment**<br>*(i) Registration Presentation (10%)*<br>*(ii) Progress Presentation-I (10%)*<br>*(iii) Project progress*: Part of working model/ process/software package/system developed (30%)*<br>*(iii) Well-documented Progress Report on Phase-I work (10%)*<br>*(iv) Video pitch on Phase-I (10%)*<br>*(v) SDG Alignment (10%)* | **80%** |
| **Total Weightage** | **100 %** |

** Students are advised to complete major part of the project in phase-I only*

(a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system, on the chosen work. The progress made in this shall be demonstrated during progress presentation-I at the end of *phase-I* and the completed working model/ process/software package/system before the DPEC as per the dates specified by DPEC at the end of *phase-II*.

(b) **Progress Report on *phase-I*:** Every project team shall be required to submit a well-documented progress report on dissertation phase-I as per format specified by DPEC.

a. **Tangible outcomes of *phase-I* in Conclusions - Chapter:** These are the lessons learnt from doing a project work. The students have to describe in their own words what they learnt from the *phase-I* project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of *phase-I* work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be presented in the conclusions chapter of *phase-I* report

(c) **Video pitch on *phase-I*:** Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I*. The project team shall present the produced video pitch during progress presentation-I. The produced video pitch should

a. be 3 to 5-minute-long video (no longer than 5 minutes)

b. be concise and to the point, on the problem and proposed solution

c. show project timeline and sample page of log book

d. highlight the progress made at various stages during *phase-I* project implementation with the help of short videos/photos / screenshots on experiments conducted, simulations carried out, part of prototype/ working model/process / software package/system being under development as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project

*e.* discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts.*

*f.* emphasize key points about *business idea, potential market for the proposed solution*

(x) It is mandatory for

(a) every student of the team to *appear for oral presentation and viva-voce*, as part of progress presentation -I to qualify for course evaluation

(b) every project team *to submit a well-documented progress report on major project work phase-I*, as part of progress presentation -I to qualify for course evaluation

(c) every project team to create and present a good video pitch on major project work *phase-I*, as part of progress presentation -I to qualify for course evaluation

(xi) A student shall register for supplementary examination for the Major project work *phase-I* in the following cases:

(a) He/she is absent for oral presentation and viva-voce as part of progress presentation-I

(b) The project team fails to submit the progress report on *Phase-I* in prescribed format

(c) The project team fails to submit the video pitch on the progress made during the *phase-I* period.

(d) he/she fails to fulfill the requirements of Major project work *phase-I* evaluation as per specified guidelines

*(xii)* Supplementary examination for Major project work *phase-I*

(a) The CoE shall send the list of students registered for supplementary examination to the HoDs concerned

(b) The DMAJPEC, duly constituted by the HoD, shall conduct Major Project Phase I supplementary exam and send the award list to the CoE within the stipulated time

| **Course Articulation Matrix (CAM):** | | **U24CI709: MAJOR PROJECT PHASE I** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | U24CI709.1 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| **CO2** | U24CI709.2 | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| **CO3** | U24CI709.3 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 3 | 1 | 2 | 1 |
| **CO4** | U24CI709.4 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 2 | 2 |
| **U24CI709** | | **2** | **2** | **1.75** | **2** | **2** | **1.75** | **2** | **1.5** | **1.75** | **175** | **2** | **2** | **1.5** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real- world complex engineering problems | **SDG 9** | Industry, Innovation and Infrastructure | Research gap identification, problem formulation, and development of innovative engineering solutions promote technological advancement, industrial innovation, and sustainable infrastructure development in ECI domains such as communication systems, IoT, VLSI, AI, and embedded systems. |
| **CO2** | design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget | **SDG 12** | Responsible Consumption and Production | Engineering design considering resource optimization, environmental impact, sustainability, and efficient utilization of technology promotes responsible production and sustainable engineering practices. |
| **CO3** | apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and | **SDG 11** | Sustainable Cities and Communities | Effective teamwork, ethical engineering practices, leadership, and multidisciplinary collaboration facilitate the development of sustainable |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement (The student should be able to…)** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| | as a member or leader of a multidisciplinary team. | | | technological solutions that improve societal well-being and community infrastructure. |
| | | **SDG3** | Good Health and Well-Being | ECI projects related to biomedical instrumentation, healthcare IoT, telemedicine, wearable sensors, and assistive technologies contribute to improved healthcare services and quality of life. |
| **CO4** | collate results, compare prototype performance with specifications, communicate findings through reports, posters, technical papers, presentations, and video pitches; engage in self-directed and lifelong learning. | **SDG 4** | Quality Education | Technical communication, dissemination of knowledge, professional documentation, and lifelong learning foster continuous education, skill enhancement, and knowledge sharing among engineering professionals. |

KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE
Opp : Yerragattu Gutta, Hasanparthy (Mandal), WARANGAL - 506 015, Telangana, INDIA.
काकतीय प्रैद्योगिकी एवं विज्ञान संस्थान, वरंगल - ५०६ ०१५ तेलंगाना, भारत
కాకతీయ సాంకేతిక విజ్ఞాన శాస్త్ర విద్యాలయం, వరంగల్ - ౫౦౬ ౦౧౫ తెలంగాణ, భారతదేశము
(An Autonomous Institute under Kakatiya University, Warangal)
(Approved by AICTE, New Delhi; Recognised by UGC under 2(f) & 12(B); Sponsored by EKASILA EDUCATION SOCIETY)
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# Semester -VIII Syllabi

## URR24 VIII SEMESTER

| S. No. | Category | Course Code | Course Title | Lectures / week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | E | C |
| 1 | PEC | U24CI801X | Program Elective - III / MOOCs-IV | 2 | 1 | - | 3 | 3 |
| 2 | PEC | U24CI802X | Program Elective - IV / MOOCs-V | 2 | 1 | - | 3 | 3 |
| 3 | PCC | U24CI803 | Satellite and Fiber Optic Communication | 2 | 1 | - | 3 | 3 |
| 4 | ELC | U24CI804 | Major Project, Phase – 2 / Industrial Internship - 2 | - | - | 12 | 12 | 6 |
| **Total:** | | | | **6** | **3** | **12** | **21** | **15** |
| Additional Learning@: Maximum credits allowed for Honours/Minor | | | | - | - | - | - | 4 |
| Total credits for Honours/Minor students: | | | | - | - | - | - | 19 |
| **Summer/ Inter-sem Bridge Courses (Approved by BoS and Dean, AA): 1 week to 10 days: 1 credit to each Bridge course under additional learning (will be printed on grade sheet)** | | | | **NIL** | | | | |

*@ List of courses for additional learning through MOOCs towards Honours/Minor in Engineering shall be prescribed by the department under Honours/ Minor Curricula*

***B. Tech Honours with Research**: Students opting for B. Tech Honours with Research, shall Publish a research paper in reputed journal indexed by SCI / SCOPUS/Web of Science (4 Credits).*

| **Program Elective – III Basket / MOOCs-III** | | |
|---|---|---|
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI801A | Embedded Linux Systems |
| 2. | U24CI801B | Cybersecurity |
| 3. | U24CI801C | Low power VLSI design |
| 4. | U24CI801D | Biomedical Signal Processing |
| 5. | U24CI801E | *Any other course approved by BoS Chair and Dean AA* |
| **Program Elective – IV Basket / MOOCs-IV** | | |
| **S. No.** | **Course Code** | **Course Title** |
| 1. | U24CI802A | Mechatronics |
| 2. | U24CI802B | Deep Learning |
| 3. | U24CI802C | Static Timing Analysis |
| 4. | U24CI802D | 5G and beyond Communications |
| 5. | U24CI802E | *Any other course approved by BoS Chair and Dean AA* |

# EMBEDDED LINUX SYSTEMS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI801A** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

- **CO1:** identify bootloader stages and set up a cross-compilation toolchain for embedded targets
- **CO2:** configure Linux kernel using Kconfig and develop loadable kernel modules for embedded hardware targets
- **CO3:** build minimal root filesystems and manage embedded storage media including flash memory types
- **CO4:** develop character and platform device drivers and apply debugging and optimization tools such as GDB, ftrace, and perf for embedded Linux applications

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Embedded Linux:** Overview of embedded systems, Differences between desktop and embedded Linux, Linux kernel architecture, Advantages of Linux for embedded systems

**System Boot Process:** Power-on sequence, Bootloader role and stages, U-Boot configuration, Kernel loading, Init process and system overview

**Cross-Compilation Toolchain:** Host vs target environments, GNU toolchain components (binutils, gcc, glibc), Crosstool-NG, Sysroot concepts, Environment variables for cross-compilation

| **UNIT-II** | **9 Hrs** |
|---|---|

**Linux Kernel Configuration and Compilation:** Kernel source tree structure, Kconfig system, Make menuconfig, Modules vs built-in drivers, Compiling and deploying the kernel image (zImage/uImage/Image)

**Device Tree:** Introduction to device trees, DTS/DTB syntax, Binding specification, Overlay support, Integrating device trees with U-Boot and the kernel

**Kernel Modules:** Loadable kernel modules (LKM), Module_init/module_exit, Makefile for out-of-tree modules, insmod/modprobe/rmmod, Module parameters

| **UNIT-III** | **9 Hrs** |
|---|---|

**Root Filesystem:** Linux directory structure (FHS), initramfs vs initrd, tmpfs/overlayfs, BusyBox for minimal userspace.

**Build Systems:** Buildroot, Directory layout, Kconfig menus, Adding custom packages, Generating SDK; Yocto Project: Layers, BitBake recipes, Image customization, Devtool workflow.

**Storage and Filesystem Management:** Flash memory types (NOR, NAND, eMMC), MTD subsystem, JFFS2/UBIFS/ext4 on embedded media, Read-only rootfs with overlay

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Device Driver Development:** Character device drivers, File_operations structure, major/minor numbers, Cdev interface, Memory-mapped I/O, GPIO and interrupt handling in drivers

**Platform and I2C/SPI Drivers:** Platform device/driver model, probe/remove lifecycle, I2C client drivers, SPI master interface, Regmap API

**Debugging and Optimization:** JTAG/OpenOCD, GDB remote debugging, strace/ltrace, ftrace, perf, Memory analysis with valgrind, Real-time considerations with PREEMPT_RT patch

**Textbook(s):**

1. Chris Simmonds, *Mastering Embedded Linux Programming*, Packt Publishing, UK, 3rd ed.

2021.

**Reference Book(s):**


1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, Philippe Gerum, *Building Embedded Linux Systems*, OReilly, 2nd ed. 2008.
2. P. Raghavan, Amol Lad, Sriram Neelakandan, *Embedded Linux System Design and Development*, Auerbach Publications (CRC Press), NY, 1st ed. 2006.
3. Robert Love, *Linux Kernel Development*, Addison-Wesley, 3rd ed. 2010.
4. Christopher Hallinan, *Embedded Linux Primer*, Prentice Hall, 2nd ed. 2010.


**Web and Video link(s):**

1. https://nptel.ac.in/courses/108102045; *NPTEL Video Lectures on Embedded Systems by Prof. Santanu Chaudhury, IIT Delhi.*

| **Course Articulation Matrix (CAM):** | | **U24CI801A: EMBEDDED LINUX SYSTEMS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI801A.1** | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| **CO2** | **U24CI801A.2** | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| **CO3** | **U24CI801A.3** | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| **CO4** | **U24CI801A.4** | 2 | 2 | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 3 | 3 |
| **U24CI801A** | | **2** | **2** | **3** | **1** | **3** | **2** | **2** | **2** | **2** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | identify bootloader stages and set up a cross-compilation toolchain for embedded targets | **SDG9** | Industry, Innovation and Infrastructure | Understanding embedded Linux architecture, the boot sequence, and cross-compilation toolchains forms the foundation for building reliable, low-cost embedded infrastructure that drives IIoT and edge computing innovation. |
| **CO2** | configure Linux kernel using Kconfig and develop loadable kernel modules for embedded hardware targets | **SDG8** | Decent Work and Economic Growth | Kernel-level development skills enable the creation of innovative embedded products and industrial automation solutions that improve productivity and create skilled employment opportunities. |
| **CO3** | build minimal root filesystems and manage embedded storage media including flash memory types | **SDG12** | Responsible Consumption and Production | Efficient filesystem design and optimized storage utilization reduce hardware resource requirements, extend device lifetimes, and promote sustainable use of computing resources. |
| **CO4** | develop character and platform device drivers and apply debugging and optimization tools such as GDB, ftrace, and perf for embedded Linux applications | **SDG9** | Industry, Innovation and Infrastructure | Device driver development, peripheral interfacing, and system debugging skills enable seamless hardware-software integration for advanced industrial systems |

# CYBER SECURITY

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI801B** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** analyze the concepts of cybercrimes, cyber offenses, attack planning methods, and information security perspectives

**CO2:** analyze security vulnerabilities and protection mechanisms in mobile and wireless computing environments

**CO3:** analyze cybercrime tools, phishing techniques, identity theft methods, and cyberattack mechanisms

**CO4:** analyze cyber laws, legal challenges, digital signatures, and cybersecurity frameworks in Indian and global contexts

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to Cybercrime:** Introduction, Cybercrime and information security, Who are Cybercriminals, Classifications of cybercrimes; Cybercrime - The legal perspectives and Indian perspective, Cybercrime and the Indian ITA 2000, A global perspective on cybercrimes

**Cyber Offenses:** How criminals plan them- Introduction, How criminals plan the attacks, Social engineering, Cyberstalking, Cybercafe and Cybercrimes; Botnets- The fuel for cybercrime, Attack vector, Cloud computing

| **UNIT-II** | **9 Hrs** |
|---|---|

**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds in mobile and wireless computing era, Security challenges posed by mobile devices, Registry settings for mobile devices, Authentication service security, Attacks on mobile/cell phones, Mobile devices, Security implications for organizations, Organizational measures for handling mobile, Organizational security policies and measures in mobile computing era, Laptops

| **UNIT-III** | **9 Hrs** |
|---|---|

**Tools and Methods used in Cybercrime:** Introduction, Proxy Servers and anonymizers, Phishing, Password cracking, Keyloggers and spywares, Virus and worms, Trojan horses and Backdoors, DoS and DDoS Attacks, SQL injection

**Phishing and Identity Theft:** Introduction, Phishing, Methods of phishing, Phishing techniques, Spear phishing, Types of phishing scams, Phishing toolkits and spy phishing, Phishing countermeasures, Identity theft (ID theft)

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Cybercrimes and Cybersecurity:** The legal perspectives- Introduction, Cybercrime and legal landscape around the world, Need of cyber laws, The Indian context, The Indian IT act, Challenges to Indian Law and cybercrime scenario in India, Digital signatures and the Indian IT act, Amendments to the Indian IT act, Cybercrime and punishment, Cyber law, Technology and students-Indian Scenario

**Textbook(s):**

1. Nina Godbole, Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, New Delhi: Wiley India Pvt. Ltd., 2011. (*Chapters 1,2,3,4,5,6*)

**Reference Book(s):**

1. James Graham, Richard Howard and Ryan Otson, *Cyber Security Essentials*, CRC Press, T&F Group, 2011, New York.
2. Chwan-Hwa (John) Wu, J. David Irwin, *Introduction to Cyber Security*, CRC Press, T&F Group, 2013, New York.
3. Thomas A Johnson, *Cyber Security Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare*, CRC Press, T&F Group, 2015, Missouri.
4. Nilakshi Jain and Ramesh Menon, *Cyber Security and Cyber Laws*, Wiley India Pvt. Ltd., 2020, New Delhi.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc23_cs127; *NPTEL video lecture on Cyber Security and Privacy, by Prof. Saji K Mathew, IIT Madras.*

| **Course Articulation Matrix (CAM):** | | **U24CI801B: CYBER SECURITY** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI801B.1** | 1 | 2 | 2 | 1 | - | - | 1 | - | 1 | - | - | 2 | 2 |
| **CO2** | **U24CI801B.2** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| **CO3** | **U24CI801B.3** | 2 | 2 | 2 | 2 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| **CO4** | **U24CI801B.4** | 2 | 2 | 3 | 3 | - | - | 1 | - | 1 | - | 2 | 2 | 2 |
| **U24CI801B** | | **1.75** | **2** | **2.25** | **1.75** | **-** | **-** | **1** | **-** | **1** | **-** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | analyze the concepts of cybercrimes, cyber offenses, attack planning methods, and information security perspectives | **SDG 4** | Quality Education | Understanding cybercrime concepts and information security enhances cybersecurity awareness, ethical practices, and digital literacy among learners and professionals. |
| **CO2** | analyze security vulnerabilities and protection mechanisms in mobile and wireless computing environments | **SDG9** | Industry, Innovation and Infrastructure | Secure mobile and wireless technologies contribute to resilient digital infrastructure, reliable communication systems, and sustainable technological innovation. |
| **CO3** | analyze cybercrime tools, phishing techniques, identity theft methods, and cyber attack mechanisms | **SDG 16** | Peace, Justice, and Strong Institutions | Understanding the anatomy of a cyber attack is essential for defending national infrastructure, mitigating digital financial fraud, and safeguarding the public from organized cybercrime networks. |
| **CO4** | analyze cyber laws, legal challenges, digital signatures, and cybersecurity frameworks in Indian and global contexts | **SDG 16** | Peace, Justice, and Strong Institutions | Studying cyber legislation and compliance frameworks ensures that digital technologies are governed by justice, accountability, and the rule of law, creating a standardized defense against global and domestic cyber chaos. |

# LOW POWER VLSI DESIGN

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI801C** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** estimate static & dynamic power dissipations in CMOS circuits using statistical techniques

**CO2:** design low voltage CMOS circuits and estimate the leakage currents due to short channel effects

**CO3:** design low power SRAM architectures and integrate energy recovery techniques used for reversible logic circuits

**CO4:** utilize software for minimizing power dissipation in VLSI circuits

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction and Need of Low Power Design**: Sources of power dissipation and design strategies for low power; Physics of power dissipation in CMOS- low power VLSI design limits; Power estimation at circuit level– Modeling of signals, Signal probability calculations, Statistical techniques, Input vector compaction, Circuit reliability

| **UNIT-II** | **9 Hrs** |
|---|---|

**Design Styles and Testing:** Low voltage CMOS circuit design styles, Leakage current in deep submission transitions and design issues, Minimization of Short channel effects and Hot carrier effects; Testing ofdeep sub-micron ICs with elevated intrinsic leakage

| **UNIT-III** | **9 Hrs** |
|---|---|

**Low Power Architectures:** MOS static RAM cells, Banked organization SRAMS, Reducing voltage swing on bit lines, Write lines, driver circuits and Sense amplifier circuits; Energy computing and recovery techniques – Energy dissipation using an RC model, Energy recovery circuit design, Design with partially reversible logic and supply clock generation

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Software Design for Low Power:** Sources of software power dissipation, Software power estimation, Software power optimizations, Automated low-power code generation and codesign for low power

**Textbook(s):**

1. Kaushik Roy and Sharad Prasad, *Low Power CMOS VLSI Circuit Design*, New Delhi: Wiley India Pvt. Ltd., 2009.

**Reference Book(s):**

1. A. P. Chandrakasan, R. W. Broderson, *Low Power design*, New York: Springer Science, 1999.
2. Gary Yeap, *Practical low power digital VLSI design*, Kluwer, 1998.
3. J. B. Kuo, J. H. Luo, *Low Voltage CMOS VLSI Circuits*, New York: John Wiley & Sons, 1999.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/106105034; *NPTEL Video Lecture on Low Power VLSI Circuits and Systems by Prof. Ajit Pal, Professor of CSE, IIT Kharagpur.*

| Course Articulation Matrix (CAM): | | U24CI801C: LOW POWER VLSI DESIGN | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI801C.1 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO2 | U24CI801C.2 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO3 | U24CI801C.3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| CO4 | U18CI801C.4 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| **U24CI801C** | | **3** | **3** | **3** | **2** | **3** | **2** | **2** | **2** | **3** | **2** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | estimate static & dynamic power dissipations in CMOS circuits using statistical techniques | **SDG9** | Industry, Innovation and Infrastructure | Efficient power estimation techniques drive innovation in semiconductor design. |
| **CO2** | design low voltage CMOS circuits and estimate the leakage currents due to short channel effects | **SDG9** | Industry, Innovation and Infrastructure | Advanced low-power design styles drive semiconductor innovation, enables efficient computing infrastructure (IoT, AI chips) and supports sustainable and resilient technology development |
| **CO3** | design low power SRAM architectures and integrate energy recovery techniques used for reversible logic circuits | **SDG13** | Climate Action | Reduced energy consumption, lower carbon emissions especially impactful in Data centers, Edge devices and direct contribution to reducing environmental impact |
| **CO4** | utilize software for minimizing power dissipation in VLSI circuits | **SDG7** | Affordable and Clean Energy | Lower CPU and memory usage → reduced electricity demand |

# BIOMEDICAL SIGNAL PROCESSING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI801D** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** explain characteristics of biomedical signals and fundamental signal processing techniques

**CO2 :** apply ECG signal processing techniques for feature extraction and arrhythmia detection

**CO3:** analyze adaptive filtering techniques for noise removal in biomedical signals

**CO4:** evaluate EEG signal processing methods for clinical applications such as epilepsy detection

| **UNIT-I** | **11 Hrs** |
|---|---|

**Introduction to Computers in Medicine:** Characteristics of medical data, Medical Instrumentation system, Medical care system, Microcomputer based medical instrument; Signal Conversion- Sampling basics, Simple signal conversion system, Conversion requirements for Bio medical signals; Signal Averaging- Basics of signal averaging, Signal averaging as a digital filter, Typical averager, Limitations of signal averaging; Time and frequency domain techniques- Fourier transform, Correlation, Convolution, Power spectrum estimation

| **UNIT-II** | **9 Hrs** |
|---|---|

**Cardiological Signal Processing:** Review of ECG, ECG data acquisition, ECG parameters for analysis; ECG QRS detection techniques -Template matching technique, Matched filter technique, Pan-Tompkins algorithm, Arrhythmia detection and analysis; Importance of ECG data compression; ECG data compression techniques- TP algorithm, AZTEC algorithm, CORTES algorithm, FAN algorithm, K-L Transform based compression technique , Entropy coding based compression technique, Comparison of ECG data compression techniques

| **UNIT-III** | **11 Hrs** |
|---|---|

**Adaptive Techniques for Signal Analysis:** Review of Adaptive filter theory, LMS Adaptive filter, Wiener filter, Adaptive implementation of Wiener filter, Steepest descent algorithm, Widrow-Hoff LMS algorithm; Applications of Adaptive Noise Canceller (Block Diagram approach)- Cancellation of PLI noise in ECG, Cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG, Cancellation of high frequency noise in Electro surgery

| **UNIT-IV** | **11 Hrs** |
|---|---|

**Neurological Signal Processing:** Review of EEG signal and its characteristics, Sleep EEG classification and Epilepsy; EEG Analysis- Time and frequency domain methods, Parametric model of EEG, EEG data segmentation using Auto regressive (AR) method, Adaptive segmentation algorithm, Transient detection and elimination in case of epileptic patient, Least squares Prony method, Modelling of evoked potential using Prony method

**Textbook(s):**

1. Willis. J. Tompkins, *Biomedical Digital Signal Processing*, PHI, 5th ed., 2003. *(Chapters 1 to 3 and 8 to 13)*
2. D.C. Reddy, *Biomedical Signal Processing: Principles and Techniques*, Tata McGraw Hill, 1st ed., 2005. (*Chapters 4 to 9*)

**Reference Book(s):**

1. RangaRaj. M. Rangayyan, *Biomedical Signal Analysis: A Case study Approach*, John Wiley & sons Inc., 1st ed., 2002.
2. Metin Akay, *Biomedical Signal Processing*, Academic Press Inc., USA, 1st ed., 1994.
3. Eugene. N. Bruce, *Biomedical Signal Processing and Signal Modelling*, John Wiley India Edn., 1st ed., 2009
4. Juan Manuel Górriz, Elmar W. Lang and Javier Ramírez, *Recent Advances in Biomedical Signal Processing*, Bentham Science Publishers, 1st ed., 2011.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc20_ee41; *NPTEL Video Lecture on Biomedical Signal Processing by Prof. Sudipta Mukhopadhyay, IIT Kharagpur.*

| **Course Articulation Matrix (CAM):** | | **U24CI801D: BIOMEDICAL SIGNAL PROCESSING** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI801D.1** | 3 | 1 | 1 | – | 1 | 2 | 1 | – | – | – | 2 | 2 | 2 |
| **CO2** | **U24CI801D.2** | 3 | 3 | 2 | 1 | 2 | 2 | – | 1 | – | – | 2 | 2 | 2 |
| **CO3** | **U24CI801D.3** | 2 | 3 | 2 | 3 | 2 | 2 | 2 | – | 1 | – | 2 | 2 | 2 |
| **CO4** | **U24CI801D.4** | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 |
| **U24CI801D** | | **2.5** | **2.5** | **2** | **1.75** | **2** | **2.25** | **1.67** | **1** | **1** | **1** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | explain characteristics of biomedical signals and fundamental signal processing techniques | **SDG3** | Good Health and Well-being | Understanding biomedical signals supports healthcare technology development |
| **CO2** | apply ECG signal processing techniques for feature extraction and arrhythmia detection | **SDG3** | Good Health and Well-being | ECG analysis helps in early diagnosis of cardiac diseases |
| **CO3** | analyze adaptive filtering techniques for noise removal in biomedical signals | **SDG9** | Industry, Innovation & Infrastructure | Adaptive filtering contributes to innovation in medical devices |
| **CO4** | evaluate EEG signal processing methods for clinical applications such as epilepsy detection | **SDG3** | Good Health and Well-being | EEG analysis aids in neurological disorder diagnosis (epilepsy) |

# MECHATRONICS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI802A** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the student s should be able to,*

**CO1:** explain the fundamentals of mechatronic systems including system elements, sensors, transducers, measurement principles, and basic control systems

**CO2 :** apply principles of pneumatic, hydraulic, mechanical, and electrical actuation systems for selecting appropriate actuators in engineering applications

**CO3:** implement input/output interfacing methods and programmable logic controller (PLC) programming concepts for automation and control applications

**CO4:** analyze mechatronic system design, timing control systems, motion control systems, and measurement systems through real-world case studies

| **UNIT-I** | **12 Hrs** |
|---|---|

**Introduction to Mechatronics:** What is mechatronics? The design process, Systems, Measurement systems, Control systems, Programmable logic controller, Examples of mechatronic systems

**Sensors and Transducers:** Performance terminology; Sensors & transducers- Displacement, Position & proximity, Velocity & motion, Force, Fluid pressure, Liquid flow, Liquid level, Temperature, Light sensors; Selection of sensors

| **UNIT-II** | **9 Hrs** |
|---|---|

**Pneumatic and Hydraulic Actuation Systems:** Importance of actuation systems; Actuation systems- Directional control valves, Pressure control valves, Cylinders, Servo & proportional control valves, Process control valves

**Mechanical Actuation Systems:** Mechanical systems, Types of motion, Kinematic chains, Cams, Gears, Ratchet & pawl, Belt & chain drives, Bearings, Electromechanical linear actuators

**Electrical Actuation Systems:** Electrical systems, Mechanical switches, Solid-state switches, Solenoids, Direct current motors, Alternating current motors, Stepper motors, Direct current servomotors, Motor selection

| **UNIT-III** | **12 Hrs** |
|---|---|

**Input/output Systems**: Interfacing, Input/output addressing, Interface requirements, Peripheral interface adapters, Serial communications interface

**Programmable Logic Controllers:** Importance of Programmable logic controller (PLC), Applications of PLC in mechatronics; PLC- Basic structure, Input/output processing, Ladder programming, Instruction lists, Latching and internal relays, Sequencing, Timers and counters, Shift registers, Master & jump controls, Data handling, Analogue input/output

| **UNIT-IV** | **12 Hrs** |
|---|---|

**Mechatronic System Design and Case Studies:** Mechatronic Design Philosophy, Timing and Control Systems, Motion Control Systems, Mechatronic Measurement Systems

**Textbook(s):**

1. William Bolton, *Mechatronics: Electronic control systems in mechanical and electrical engineering*, 7th ed., Pearson Education Limited, New York. (*Chapters: 1, 3, 4, 5, 6, 7, 14*)

**Reference Book(s):**

1. Robert H. Bishop, *Mechatronic System Control, Logic, and Data Acquisition*, 2nd ed., CRC

Press, New York, 2007.
2. Naveenkumar, Pushpalatha & Sharma, Vandana & Devarajan, Gunapriya, *Handbook of AI-Based Mechatronics Systems and Smart Solutions in Industrial Automation*, 1st ed., CRC Press, New Tork, 2025.

**Web and Video link(s):**

1. https://nptel.ac.in/courses/112107298; *NPTEL Video Lecture on Mechatronics by Prof. Pushparaj Mani Pathak, IIT Roorkee.*

| **Course Articulation Matrix (CAM):** | | **U24CI802A: MECHATRONICS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **Course Code** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI802A.1** | 3 | 1 | – | – | 1 | – | – | – | – | – | 2 | 2 | 2 |
| **CO2** | **U24CI802A.2** | 3 | 2 | 2 | 1 | 2 | – | – | – | – | – | 2 | 2 | 2 |
| **CO3** | **U24CI802A.3** | 2 | 3 | 2 | 3 | 3 | – | 1 | 1 | 1 | – | 2 | 3 | 2 |
| **CO4** | **U24CI802A.4** | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | 1 | 2 | 3 | 3 |
| | **U24CI802A** | **2.50** | **2.25** | **2.33** | **2.33** | **2.25** | **2** | **1** | **1.5** | **1** | **1** | **2** | **2.5** | **2.25** |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | explain the fundamentals of mechatronic systems including system elements, sensors, transducers, measurement principles, and basic control systems | **SDG4** | Quality Education | Provides interdisciplinary engineering knowledge and strengthens conceptual understanding required for modern engineering education |
| **CO2** | apply principles of pneumatic, hydraulic, mechanical, and electrical actuation systems for selecting appropriate actuators in engineering applications | **SDG9** | Industry, Innovation & Infrastructure | Supports development of automation technologies and innovative industrial systems contributing to sustainable infrastructure |
| **CO3** | implement input/output interfacing methods and programmable logic controller (PLC) programming concepts for automation and control applications | **SDG8** | Decent Work and Economic Growth | Enhances employability skills in industrial automation and improves productivity through intelligent control systems |
| **CO4** | analyze mechatronic system design, timing control systems, motion control systems, and measurement systems through real-world case studies | **SDG12** | Responsible Consumption and Production | Encourages efficient system design, optimal resource utilization, and sustainable engineering solutions |

# DEEP LEARNING

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI802B** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** explain the fundamental principles of neural networks, including perceptrons, activation functions, and back propagation

**CO2:** implement optimization algorithms, regularization techniques, and communication signal pre-processing methods

**CO3:** construct Convolutional Neural Networks (CNNs) using convolution and pooling operations for multi-dimensional data

**CO4:** design sequence modelling architectures, including RNNs, LSTMs, and encoder-decoders, for sequential data analysis

| **UNIT-I** | **9 Hrs** |
|---|---|

**Fundamentals of Neural Networks & Deep Learning:** Introduction to Machine learning vs Deep learning; Role of DL in communication engineering— Motivation and applications, Biological neuron to artificial neuron, McCulloch-Pitts model; Perceptron- Learning rule, Limitations, Multi-Layer Perceptron (MLP); Feed-forward networks, Universal approximation theorem, Activation & Loss functions; Back propagation algorithm- Chain rule, Gradient computation

| **UNIT-II** | **9 Hrs** |
|---|---|

**Optimizers & Regularization:** SGD, Momentum, RMSProp, Adam-convergence behaviour, Learning rate scheduling, L1/L2 penalties, Dropout, Batch normalization, Early stopping, Over fitting vs Under fitting

**Data pre-processing:** Normalization, I/Q representation, Dataset augmentation, Implementation of DL-based SNR estimation in AWGN channel by Tensor Flow/PyTorch

| **UNIT-III** | **9 Hrs** |
|---|---|

**Convolution Neural Networks:** Convolution operation, Motivation, Pooling, Convolution and pooling as an Infinitely strong prior, Variants of the basic convolution function, Structured outputs, Data types, Efficient convolution algorithms, Convolutional Nural Networks (CNNs), History of Deep learning

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Sequence Modelling:** Recurrent and recursive nets, Unfolding computational graphs, Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder-Decoder, Sequence-to-Sequence architectures, Deep Recurrent Networks (DRNNs), Recursive neural networks, Long Short-Term Memory (LSTM), Other gated RNNs

**Textbook(s):**


1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, MIT Press, 2016.
2. Haykin, *Neural Simon networks and Learning Machines*, 3rd ed., Pearson, 2016


**Reference Book(s):**


1. François Chollet, *Deep Learning with Python*, Manning Publications, 2018.
2. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow*, 2nd ed., O'Reilly Media, 2019.
3. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.


**Web and Video link(s):**

1. https://youtu.be/aPfkYu_qiF4?si=k1d9FmDQYGMtI1mm*; NPTEL Video Lecture on Deep*

| **Course Articulation Matrix (CAM):** | | **U24CI802B: Deep Learning** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI802B.1** | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO2** | **U24CI802B.2** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO3** | **U24CI802B.3** | 3 | 3 | 3 | 2 | 3 | 1 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **CO4** | **U24CI802B.4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 | 3 | 3 |
| **U24CI802B** | | **3** | **2.8** | **2.8** | **2** | **3** | **1.3** | **2** | **1** | **1** | **1** | **3** | **3** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement**<br>*The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | explain the fundamental principles of neural networks, including perceptrons, activation functions, and back propagation | **SDG 9** | Industry, Innovation and Infrastructure | apply neural network fundamentals, activation functions, and backpropagation to engineer intelligent systems for industrial innovation and smart infrastructure. |
| **CO2** | implement optimization algorithms, regularization techniques, and communication signal pre-processing methods | **SDG 9** | Industry, Innovation and Infrastructure | Implementing optimization algorithms, regularization techniques, and signal pre-processing methods improves the efficiency, accuracy, and reliability of AI-based communication and industrial systems, thereby contributing to technological innovation and modern infrastructure. |
| **CO3** | construct Convolutional Neural Networks (CNNs) using convolution and pooling operations for multi-dimensional data | **SDG 9** | Industry, Innovation and Infrastructure | Constructing Convolutional Neural Networks (CNNs) for multidimensional data analysis supports advanced applications such as image processing, automation, and intelligent monitoring systems, promoting innovation in industrial and technological infrastructure. |
| **CO4** | design sequence modelling architectures, including RNNs, LSTMs, and encoder-decoders, for sequential data analysis | **SDG 9** | Industry, Innovation and Infrastructure | Designing sequence modeling architectures such as RNNs, LSTMs, and encoder–decoder models enhances intelligent analysis of sequential data in communication, automation, and predictive systems, thereby strengthening industrial innovation and smart infrastructure development. |

# STATIC TIMING ANALYSIS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI802C** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** utilize STA concepts for CMOS logic design

**CO2:** design the combinational & sequential standard cells using advanced timing models

**CO3:** analyze the combinational & sequential standard cells using interconnect parasitic extraction & delay model

**CO4:** analyze crosstalk noise modeling, timing correlation & functional correlation for combinational & sequential standard cells

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction:** need of static timing analysis (STA), Limitations of static timing analysis, Power considerations and reliability considerations

**STA Concepts:** CMOS logic design, Basic MOS structure, CMOS logic gate standard cells, Modeling of CMOS cells switching waveform, Propagation delay, Slew of a waveform, Skew between signals, Timing arcs and unateness, Min and max timing paths, Clock domains, Operating conditions

| **UNIT-II** | **9 Hrs** |
|---|---|

**Standard Cell Library:** Pin capacitance, Timing modeling, Timing models-combinational cells, Timing models- sequential cells, State-dependent models, Interface timing model for a black box, Advanced timing modeling, Models for crosstalk noise analysis, Power dissipation modeling

| **UNIT-III** | **9 Hrs** |
|---|---|

**Interconnect Parasitics:** RLC for interconnect, Wire load models, Representation of extracted parasitics, Representing coupling capacitances, Hierarchical methodology, Reducing parasitics for critical nets

**Delay Calculation:** Overview, Cell delay using effective capacitance, Interconnect delay, Slew merging, Different slew thresholds, Different voltage domains, Path delay calculation and slack calculation

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Crosstalk and Noise:** Overview, Crosstalk glitch analysis, Types of glitches-rise and fall glitches, Overshoot & undershoot glitches, Glitch thresholds & propagation, Noise accumulation with multiple aggressors, Aggressor timing correlation, Aggressor functional correlation, Crosstalk delay analysis, Timing verification using crosstalk delay, Computational complexity, Noise avoidance techniques

**Textbook(s):**


1. J. Bhasker, R. Chadha, *Static Timing Analysis for Nanometer Designs: A Practical Approach*, New Delhi: Springer, 2009. (*Chapter 1 to 6*)


**Reference Book(s):**


1. R. Jayagowri, Pushpendra S. Yadav, *Static Timing Analysis for VLSI circuits*, New Delhi: MEDTECH, A Division of Scientific International, 2018.
2. Naresh Maheshwari and Sachin S. Sapatnekar, *Timing Analysis and Optimization of Sequential Circuits*, Berlin: Springer Science, 1999.


**Web and Video link(s):**

1. https://nptel.ac.in/courses/108107380; *NPTEL Video Lecture on VLSI Physical Design with Timing Analysis by Prof. Bishnu Prasad Das, Professor of ECE, IIT Roorkee.*

| **Course Articulation Matrix (CAM):** | | **U24CI802C : STATIC TIMING ANALYSIS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO 3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI802C.1** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| **CO2** | **U24CI802C.2** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| **CO3** | **U24CI802C.3** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| **CO4** | **U18CI802C.4** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 |
| **U24CI802C** | | **3** | **3** | **3** | **2** | **3** | **2** | **2** | **2** | **3** | **2** | **2** | **2** | **2** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | utilize STA concepts for CMOS logic design | **SDG7** | Affordable and Clean Energy | STA helps optimize circuits to avoid unnecessary power overhead and prevents overdesign, reducing energy consumption |
| **CO2** | design the combinational & sequential standard cells using advanced timing models | **SDG9** | Industry, Innovation and Infrastructure | Advanced standard cell design enables high-performance processors, efficient semiconductor ecosystem and drives innovation in VLSI and computing infrastructure |
| **CO3** | analyze the combinational & sequential standard cells using interconnect parasitic extraction & delay model | **SDG12** | Responsible Consumption and Production | Reduces design rework, silicon wastage and efficient use of materials and manufacturing resources |
| **CO4** | analyze crosstalk noise modeling, timing correlation & functional correlation for combinational & sequential standard cells | **SDG13** | Climate Action | Optimized designs lower power consumption, reduce emissions and contributes to environmentally sustainable electronics |

# 5G AND BEYOND COMMUNICATIONS

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI802D** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** explain the evolution, architecture, services & standards of 5G wireless communication systems

**CO2:** analyze advanced physical layer technologies such as OFDM, Massive MIMO, beamforming & mmWave communications used in 5G networks

**CO3:** apply multiple access techniques, cognitive radio & intelligent spectrum management methods in modern wireless communication systems

**CO4:** interpret Beyond-5G applications, AI/ML enabled wireless networks & emerging 6G technologies

| **UNIT-I** | **9 Hrs** |
|---|---|

**Introduction to 5G Wireless Systems:** Evolution of wireless communication systems-1G to 5G, Requirements and challenges of 5G networks, LTE, LTE-Advanced and LTE-A Pro overview, 5G NR architecture and protocol stack; Service categories- eMBB, URLLC and mMTC, Spectrum allocation and IMT-2020 standards, Small cells and heterogeneous networks

| **UNIT-II** | **9 Hrs** |
|---|---|

**Advanced PHY Layer Technologies:** OFDM fundamentals and limitations; Advanced waveforms- FBMC, GFDM and UFMC; Massive MIMO systems, Beamforming techniques, Hybrid beamforming, Millimeter-wave (mmWave) communications, 5G channel models, Carrier aggregation and bandwidth parts

| **UNIT-III** | **9 Hrs** |
|---|---|

**Multiple Access and Spectrum Management:** Non-Orthogonal Multiple Access (NOMA), SCMA, Power-domain NOMA, Resource allocation techniques, Interference management, Cognitive radio networks, Dynamic spectrum sharing, Spectrum sensing techniques

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Beyond 5G and Emerging Technologies:** Device-to-Device (D2D) communication, Internet of Things (IoT) in 5G, Vehicle-to-Everything (V2X) communication, UAV-assisted communication, Edge computing and network slicing, AI/ML in wireless communication, Reconfigurable Intelligent Surfaces (RIS), Introduction to 6G technologies, Security challenges in 5G/B5G systems

**Textbook(s):**


1. Dahlman E., Parkvall S., and Skold J., *5G NR: The Next Generation Wireless Access Technology*, 2nd ed., Academic Press, 2020.
2. Vaezi M., Ding Z., and Poor H. V., *Multiple Access Techniques for 5G Wireless Networks and Beyond*, Springer, 2019.


**Reference Book(s):**


1. Andrea Goldsmith, *Wireless Communications*, Cambridge University Press, 2005.
2. Andreas F. Molisch, *Wireless Communications: From Fundamentals to Beyond 5G*, 3rd ed., Wiley, 2022.
3. Mohammad A. Matin, *Spectrum Access and Management for Cognitive Radio Networks*, Springer, 2017.

4. Mojtaba Vaezi, Zhiguo Ding, H. Vincent Poor, *Multiple Access Techniques for 5G Wireless Networks and Beyond*, 1st ed., Springer International Publishing, Cham, Switzerland, 2019.

**Web and Video link(s):**

1. https://onlinecourses.nptel.ac.in/noc24_cs34; *NPTEL Video Lecture on Introduction to Industry 4.0 and Industrial Internet of Things by Prof. Sudip Misra, Prof. of CSE, IITKGP.*
2. https://www.qualcomm.com/5g/what-is-5g; *Qualcomm Tutorial on 5G Fundamentals, Architecture and Applications.*
3. https://www.mathworks.com/videos/series/understanding-the-5g-nr-standard.html; *MATLAB and Simulink Video Series on 5G NR Standard and PHY Layer Technologies*
4. https://www.3gpp.org; *Official 3GPP Website for 5G NR Standards and Releases*

| **Course Articulation Matrix (CAM):** | | **U24CI802D: 5G AND BEYOND COMMUNICATIONS** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI802D.1** | 2 | 2 | 1 | - | - | - | - | - | 1 | - | 2 | 2 | - |
| **CO2** | **U24CI802D .2** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | - | 3 | - |
| **CO3** | **U24CI802D.3** | 2 | 3 | 2 | 2 | 1 | - | - | - | - | - | 2 | - | 3 |
| **CO4** | **U24CI802D.4** | 2 | 2 | 2 | - | 1 | - | 1 | - | - | - | 3 | - | 3 |
| **U24CI802D** | | **2.25** | **2.25** | **1.75** | **2** | **1** | **-** | **1** | **-** | **1** | **-** | **2.33** | **2.5** | **3** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO** | **CO Statement** | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
|---|---|---|---|---|
| **CO1** | explain the evolution, architecture, services & standards of 5G wireless communication systems | **SDG9** | Industry, Innovation and Infrastructure | 5G wireless communication technologies support modern digital infrastructure, smart connectivity and innovation in communication systems. |
| **CO2** | analyze advanced physical layer technologies such as OFDM, Massive MIMO, beamforming & mmWave communications used in 5G networks | **SDG9** | Industry, Innovation and Infrastructure | Advanced PHY layer technologies improve spectral efficiency, network capacity and high-speed communication infrastructure for future wireless systems. |
| **CO3** | apply multiple access techniques, cognitive radio & intelligent spectrum management methods in modern wireless communication systems | **SDG7** | Affordable and Clean Energy | Efficient spectrum utilization and intelligent resource allocation reduce energy consumption and improve sustainable wireless communication systems. |
| **CO4** | interpret Beyond-5G applications, AI/ML enabled wireless networks & emerging 6G technologies | **SDG11** | Sustainable Cities and Communities | AI-enabled 5G/6G technologies support smart cities, intelligent transportation, IoT applications and sustainable urban communication infrastructure. |

# SATELLITE AND FIBER OPTIC COMMUNICATION

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI803** | **Credits:** | **3** |
| **Hours/Week (L-T-P- E):** | **2-1-0-3** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **36 Hrs** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**

*After completion of this course, the students should be able to,*

**CO1:** interpret & select appropriate technologies for implementation of specified satellite communication systems

**CO2:** select an appropriate modulation, multiplexing, coding & multiple access schemes for a given satellite communication link

**CO3:** analyse optical fiber structures, fiber splicing, optical sources & detectors

**CO4:** examine optical receivers, analog links & network concepts

| **UNIT-I** | **9 Hrs** |
|---|---|

**Satellite Orbits and Trajectories:** Definition, Basic principles, Orbital parameters, Injection velocity and satellite trajectory, Types of satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance- Eclipses, Look angles, Azimuth angle, Elevation angle

**Satellite Subsystem:** Power supply subsystem, Altitude and orbit control, Tracking, Telemetry and command subsystem, Payload

**Earth Station:** Types of earth station, Architecture, Design considerations, Satellite tracking

| **UNIT-II** | **9 Hrs** |
|---|---|

**Multiple Access Techniques:** Introduction, FDMA, SCPC systems, MCPC systems, TDMA, CDMA, SDMA

**Satellite Link Design Fundamentals:** Transmission equation, Satellite link parameters, Propagation considerations

**Communication Satellites:** Introduction, Related applications, Frequency bands, Payloads, Satellite vs. Terrestrial networks, Satellite telephony, Satellite television, Satellite radio, Regional satellite systems, National satellite systems

| **UNIT-III** | **9 Hrs** |
|---|---|

**Optical Fibers – Structure and Wave guiding**: Major elements of an optical fiber link, Nature of light, Basic optical laws and definitions, Fiber modes and configurations, Single mode and multi-mode fibers, Step index fiber and graded index fiber

**Fiber Splicing, Optical Sources and Detectors:** Splicing techniques, Optical fiber connectors - connector types and connector return loss; Light emitting diode, LASER diode, PIN photo detector and avalanche photodiode

| **UNIT-IV** | **9 Hrs** |
|---|---|

**Optical Receiver:** Fundamental receiver operation, Digital signal transmission, Error sources, Digital receiver performance, Probability of error, Receiver sensitivity, Quantum limit, Eye diagrams, Eye pattern features, BER, Q-factor measurements and coherent detection

**Analog links and Network concepts:** Carrier to noise ratio, Carrier power, Relative intensity noise, Limiting conditions of RIN, WDM and dense WDM, Network topology, Network categories, Network layers, Optical layers, SONET and WDM network

**Textbook(s):**

5. Anil K. Maini, Varsha Agrawal, *Satellite Communications*, New Delhi: Wiley India Pvt. Ltd., 2015.
6. Gerd Keiser, *Optical Fiber Communications*, 5th ed., New Delhi: McGraw Hill, 2017.

**Reference Book(s):**

11. Timothy Pratt, Charles Bostian, Jeremy Allnutt, *Satellite Communications*, 2nd Edition, New Delhi: Wiley India Pvt. Ltd, 2017.
12. Dennis Roddy, *Satellite Communications*, 4th Edition, New Delhi: McGraw- Hill International edition, 2006.
13. John M. Senior, *Optical Fiber Communications - Principles and practice*, 3rd Edition, New Delhi: Pearson, 2010.
14. P. Chakrabarti, *Optical Fiber Communications*, New Delhi: McGraw Hill, 2015.

**Web and Video link(s):**

5. https://onlinecourses.nptel.ac.in/noc25_ee90; *NPTEL Video Lecture on Fiber Optic Communication Technology by Prof. Deepa Venkitesh, Professor of EE, IIT Madras*
6. https://nptel.ac.in/courses/117105131; *NPTEL Video Lecture on Satellite communication by Prof. Kalyan Kumar Bandyopadhyay, Professor of EE, IIT Kharagpur*

| **Course Articulation Matrix (CAM):** | | **U24CI803: SATELLITE AND FIBER OPTIC COMMUNICATION** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| **CO1** | **U24CI803.1** | 2 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| **CO2** | **U24CI803.2** | 2 | 2 | 1 | 2 | - | - | 1 | 1 | 1 | 1 | - | 2 | 1 |
| **CO3** | **U24CI803.3** | 2 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | - | 1 | 1 |
| **CO4** | **U24CI803.4** | 2 | 2 | 2 | 1 | 1 | - | - | 1 | 1 | 1 | - | 1 | 1 |
| **U24CI803** | | **2** | **2** | **1.5** | **1.5** | **0.5** | **-** | **0.5** | **1** | **1** | **1** | **-** | **1.5** | **1** |
| **3 – HIGH, 2 – MEDIUM, 1 - LOW** | | | | | | | | | | | | | | |

| **CO–SDG Alignment Matrix** | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO1** | interpret & select appropriate technologies for implementation of specified satellite communication systems | **SDG4** | Quality Education | Engineers design and build resilient infrastructure, promote innovation, and develop advanced technologies in communication and industrial sectors Satellite communication is a key technology for developing advanced communication infrastructure, enabling global connectivity, remote communication services, and innovative solutions in telecommunications |
| | | **SDG9** | Industry, Innovation and Infrastructure | |

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| **CO** | **CO Statement** *The student should be able to…* | **Relevant SDG** | **SDG Description** | **Mapping Justification** |
| **CO2** | select an appropriate modulation, multiplexing, coding & multiple access schemes for a given satellite communication link | **SDG4** | Quality Education | Supports development of reliable, efficient, and innovative technological infrastructure<br>Satellite link analysis and optimization improve communication reliability, bandwidth utilization, and performance of modern communication networks, contributing to innovative communication infrastructure |
| | | **SDG9** | Industry, Innovation and Infrastructure | |
| **CO3** | analyse optical fiber structures, fiber splicing, optical sources & detectors | **SDG4** | Quality Education | Promotes development of sustainable industries and advanced communication infrastructure through technological innovation<br>Optical fiber technology provides high-speed, reliable, and energy-efficient communication networks that form the backbone of modern digital infrastructure |
| | | **SDG9** | Industry, Innovation and Infrastructure | |
| **CO4** | examine optical receivers, analog links & network concepts | **SDG4** | Quality Education | Encourages resilient infrastructure development and technological advancement<br><br>Understanding optical receivers and networking concepts helps in designing efficient communication systems, supporting internet connectivity, digital transformation, and smart infrastructure development. |
| | | **SDG9** | Industry, Innovation and Infrastructure | |

# MAJOR PROJECT PHASE-II

| | | | |
|---|---|---|---|
| **Class:** B. Tech. VIII – Semester | | **Branch:** ECI | |
| **Course Code:** | **U24CI804** | **Credits:** | **6** |
| **Hours/Week (L-T-P- E):** | **0-0-12-12** | **CIE:** | **60%** |
| **Total Number of Teaching Hours:** | **-** | **ESE:** | **40%** |

**Course Learning Outcomes (COs)**:
*After completion of this course, the students should be able to,*

Upon completion of the major project work, students will be able to…

**CO1:** review research literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems (**Technical skills**)

**CO2:** design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget (**Problem solving and critical thinking skills**)

**CO3:** apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader to produce time-sensitive deliverables in a multi-disciplinary team (**Ethics and teamwork**)

***CO4:*** collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer (**Communication skills and life-long learning**)

1. **Major project work shall be continued in 8$^{th}$ semester as major project *phase-II*:** All the major project teams shall take the *phase -I* work forward and complete the remaining work as *Phase-II* in the 8$^{th}$ semester.
2. Final Year Major Project work represents the culmination of study towards the B. Tech degree. **Major project offers an opportunity to integrate the knowledge acquired from various courses and apply it to solve real-world complex engineering problems**. The **student learning assessment process** (SLAP) shall include good number of presentations, demonstration of work undertaken, submission of a project report, writing project paper in scientific journal style & format, preparing project poster and creating video pitch on the complete project
3. Activities of major project SLAP shall be planned in such a way to ensure that the students acquire the essential knowledge, skills and qualities (KSQ) of a professional engineer.
4. **Team work:** Major project work is a team work
   (i) The students of a project team shall work together to achieve a common objective.
   (ii) Every student of a project team is expected to function effectively as an individual, and also with others as a team member in an ecosystem of team having knowledge diversity, gender diversity, social and cultural diversity among its members.
5. Every student is expected to put approximately **168 hours of work** into the major project phase-II course over the 12 weeks of 8$^{th}$ semester.
6. **Major project work *Phase-II*: 8$^{th}$ semester**
   (i) The convener DPEC shall release complete schedule of *phase-II* CIE during last week of 7$^{th}$ semester (*well in advance before start of 8$^{th}$ semester*), immediately after completion of Progress Presentation-I, so

that student teams would complete the scheduled works during inter-semester break and get ready with informative, confident and comfortable presentation for progress presentation-II.

(ii) The project supervisors: The project supervisors are expected to guide the students to systematically continue the phase-I work, useful work during inter- semester break, meeting the deadlines as proposed in project timeline.

(iii) The project supervisors shall ensure students focus on the project objectives and expected deliverables

(iv) The project supervisors shall ensure students have sufficient resources for successful project completion.

(v) The project supervisors shall ensure students have sufficient resources for successful project completion.

(vi) The project supervisors shall continue guiding students on

(a) *Knowledge, skills and qualities (KSQ) of a professional engineer to be acquired* to propose solutions and design the systems to theidentified real-world problems.

(b) *Problem analysis* - to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

(c) *Applying engineering knowledge* - to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

(d) *Design/development of solutions* - to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental Considerations

(e) *Conduct investigations of complex problems* - to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions

(f) *Modern tool usage* – to create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

(g) *The Engineering and the world* – to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

(h) *Ethics* – to apply ethical principles and commit to professional ethics, responsibilities, and norms of the engineering practice

(i) *Individual and team work* – to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

(j) *Communication* – to communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

(k) *Project management and finance* – to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

(l) *Life-long learning* – to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

(vii) The project supervisors are also expected to continuously emphasize and guide the students on

(a) **Following project timeline**: completing the tasks as planned in project timeline

(b) **Meeting Cadence:**

i. **Regular meetings with supervisor:** Short and frequent meetings increase a team's work momentum. Regular meetings with supervisor to review the status of project are very essential. All students of the team shall participate in discussions and take notes.

ii. **Meeting Frequency: Semi-weekly cadence,** i.e., the meeting frequency shall be **twice a week.** Due weightage will be given to meeting cadence and considered for evaluation during presentations, i.e., number of planned meetings and number attended by students

(c) **Project Log Book:** The activity journaling in project log book is very important for a successful project.

i. Project log book is a written record showing the daily project activity on project goals from the very first thing like starting the project (an introduction statement what the project is all about), to the completion of the work (including the final results, and whether project met the core objectives / outcomes, etc.).

ii. In project log book, the activities like regular meetings with project supervisor, and work carried out on daily/weekly basis are to be recorded. This ensures that the student progress is being monitored well.

iii. The project supervisor shall regularly check the log book of every student of project team and endorse each and every activity by affixing his signature with date. With this, the number of planned meetings and number attended by the students will be also monitored.

iv. Log books are to be shown during all presentations and will be graded along with the project.

v. At the conclusion of the project work *phase-II*, the supervisor shall specifically comment, in the project log book, on whether the project team met each of the project work outcomes and to give evidence which describes the quality of work. For project teams, this also serves as self-assessment.

(d) **Writing down whatever is done and making notes of whatever is read**. Writing down the procedures / models followed, designs made, experiments conducted, simulations carried out, intermediate results obtained, ***difficulties faced and how they were fixed*** are very important. This kind of documenting the whole process as we go with project implementation is a very effective way and will help preparing a well- documented report having original content. Note down and include information about all the resources that you used, magazines, Journals, patents, books, and so on. This information will be needed for the bibliography in your project report. On the other hand, documenting a report ***on the spur of the moment*** would end up copying things from other sources resulting in a plagiarized document.

(e) The relevant knowledge, skills and qualities (**KSQ**) an engineering graduate should possess, which can be specially acquired by participating in major project work

(f) **Good and sufficient literature review**: Literature review is a description and analysis of information related to the topic of project work. Reading good number of review articles, research articles published in recent issues of peer reviewed journals, technical magazines, patents, reference books on the topics of potential interest, will help one understand what has already been discovered and what questions remain to identify gaps in the literature.

(g) Completing the proposed work by the end of *phase-II*

(h) Right conduct of research to promote academic integrity, honesty and time management

(i) Preparing a well-documented overall project report in proper format, covering the complete work carried out during both the phases (*phase-I and phase-II*).

(j) Consequences of plagiarism, and use of anti-plagiarism software to detect plagiarism in the report

(k) Submission of major project work report within acceptable plagiarism levels (including AI Plagiarism), as per the ***Anti-plagiarism policy-2020 of our institute***

(l) **Video pitch on complete project work**: Capturing short videos, photos, screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed during course of project execution, photos showing interaction with supervisor for creating a short video pitch on the complete work done during both phases (*phase-I and phase-II*).

(m) **Project Paper**: Writing a technical paper at the end of *phase-II* based on the solution(s) proposed, results obtained and prototype / working model / process / software package / system developed, for submission to a reputed non-predatory conference/non-paid peer reviewed journal.

(n) **Project poster**: At the end of phase-II, the project teams shall have to present their project in the form of posters, at the time of demonstration of complete porotype / working model / software package / system developed.

(viii) **Phase – II evaluation**: There shall be only Continuous Internal Evaluation (CIE) for major project work *phase-I* with following components

(a) **Progress Presentation -II** *(during third / fourth week of 8$^{th}$ semester):* The progress presentation-II shall include the identified problem, objective(s), literature review, expected outcome(s), results of work done as per project plan timeline.

i. **Following project timeline**: The project timeline shall be meticulously followed and the tasks shall be completed as planned in project timeline.

ii. 80-85% of work is expected to be completed

iii. Project teams shall compulsorily show the following as part of their progress presentation-II

1. *The slides on project timeline and*
2. *A table showing targeted tasks as per timeline and status – whether tasks accomplished?*

iv. **Project log book**: Every student of the Project team shall compulsorily show the activity journaling in the log book (with due signatures of project supervisor) during presentations

(b) **Final Presentation** *(during penultimate week of 8$^{th}$ semester):* **Project supervisor shall ensure that the project team has accomplished 100% of work proposed**. The project team shall

i. **Follow project timeline**: The project timeline shall be meticulously followed and the tasks shall be completed as planned in project timeline.

ii. compulsorily show the following as part of their final presentation

1. *The slides on project timeline and*
2. *A table showing targeted tasks as per timeline and whether all the identified tasks accomplished?*

iii. **show project log book**: Every student of the Project team shall compulsorily show the complete activity journaling in the log book (*with due signatures of project supervisor*)

iv. present complete results & analysis

v. **demonstrate the completed project**: working model / process / software package / system developed

vi. demonstrate the completed project with the **project poster presentation**

(ix) **Evaluation for Major project phase-II:** There shall be continuous internal evaluation (CIE) and end semester examination (ESE). The evaluation for *phase-II* shall be as given below:

| Assessment | Weightage |
|---|---|
| **(i) CIE**<br>**(ii) Supervisor Assessment (10%)**<br>**(iii) DMAJPEC Assessment (50%)**<br>*(a) Progress presentation-II (5%)*<br>*(b) Final presentation (5%)*<br>*(c) Working model/process/software package/system developed (15%)*<br>*(d) Project video pitch (5%)*<br>*(e) Project paper (5%)*<br>*(f) Project poster (5%)*<br>*(DMAJPEC shall evaluate the project poster, as per the rubrics, well before the ESE. At the time of ESE, evaluated project poster marks shall be posted in the award list. Students shall appear for Viva-Voce with project poster)*<br>*(g) SDG Alignment (10%)* | **60%** |
| **B. ESE**<br>*(i) Well-documented project report (10%)*<br>*(DMAJPEC shall evaluate the project reports, as per the rubrics, well before the ESE. At the time of ESE, evaluated project report marks shall be posted in the award list, along with the ESE oral presentation marks. Students shall appear for Viva-Voce with project report)*<br>*(ii) Oral presentation with PPTs and viva-voce (20%)*<br>*(iii) SDG Alignment (5%)*<br>*(iv) Research Orientation (5%)* | **40%** |
| **Total Weightage** | **100%** |

(a) **Working Model:** Every project team shall be required to develop a working model/ process/software package/system on the chosen work. The completed working model/ process/software package/system shall be demonstrated during the final presentation at the end of *phase-II*.

(b) **Video pitch**: Every project team shall be required to create a pitch video, which is a video presentation on their major project work *phase-I & phase-II*. The project team shall present the produced video pitch during Final presentation. The produced video pitch should

**(i)** be 3 to 5-minute-long video (no longer than 5 minutes)

***(ii)*** be concise and to the point, on the problem, proposed solution and its salient features.

**(iii)** show project timeline and sample page of log book

**(iv)** highlight the various stages during project implementation with the help of short videos/ photos/ screenshots on experiments conducted, simulations carried out, prototype / working model / process / software package / system developed as part of proposed solution and also photos showing team interactions with supervisor and the team working in the lab on project.

***(v)*** discuss the impact of proposed solution in *ethical, environmental, societal and sustainable development contexts.*

*(vi)* emphasize key points about *business idea, potential market for the proposed solution*

(c) **Project poster**: At the end, the project teams shall present their project in the form of posters (A2 size). The teams shall have to present their work during the poster presentation session scheduled at the end of the 8th semester, at the time of demonstration of complete porotype / working model / software package / system developed.

(d) **Well-documented plagiarism-cleared project report**: Every project team shall be required to submit a well-documented project report on the work carried out, as per the format specified by the DPEC. The report should clear plagiarism check as per the anti-plagiarism policy-2020 of the institute. The following shall compulsorily be included in the Results-Chapter of the project report

(i) Photos / screen shots taken at various stages during the development of working model/ process/software package/system as part of Results-Chapter

(ii) Snapshot of final working model/ process/software package/system developed

(iii) Pictures of the team working in the lab, the team discussing with the project supervisor, working on creative project, or an event they are attending for work.

*(iv)* All *these photos / screen shots shall be properly referred in the project report by assigning figure numbers*

(e) **Tangible outcomes of project work in Conclusions - Chapter:** These are the lessons learnt from doing a project work. The students have to describe in their own words what they learnt from the project work experience. They have to describe what specific KSQs are acquired by them, with reference to the expected COs, after successful completion of major project work. Finally, a table depicting systematic mapping of what they have learnt and the expected major project work COs, is to be shown in the conclusions chapter.

(f) **Student feedback on major project in Conclusions - Chapter:** To gather information on whether project work was useful and gave practical experience on chosen field of interest, and other learning, a well-defined feedback questionnaire (*made available by the dept*) with closed and open questions shall be kept in the conclusions chapter of the project report.

(x) It is mandatory for

(a) every student of the team to appear for ESE oral presentation and viva-voce, to qualify for course evaluation

(b) every project team to write a technical paper based on the solution(s) proposed, results obtained and prototype/working model/process/software package/system developed, for submission to a reputed non-predatory conference/non-paid peer-reviewed journal

(c) every project team shall be required to create a pitch video, which is a video presentation on their major project work phase-I & phase-II

(d) every project team shall present their project in the form of a poster, during the demonstration of complete prototype/working model/software package/system developed

(xi) The student has to register for the Major project work phase-II as supplementary examination in the following cases:

(a) he/she is absent for oral presentation and viva-voce as part of ESE presentation

(b) he/she fails to fulfill the requirements of Major project work phase-II evaluation as per specified guidelines

*(xii)* Supplementary examination for Major project work phase-II

(a) The CoE shall send the list of students registered for supplementary examination to the HoDs concerned

**(b)** The DPEC, duly constituted by the HoD, shall conduct Major Project Phase-II supplementary

| Course Articulation Matrix (CAM): | | U24CI804: MAJOR PROJECT PHASE II | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1 | U24CI804.1 | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| CO2 | U24CI804.2 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 1 |
| CO3 | U24CI804.3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 |
| CO4 | U24CI804.4 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |
| U24CI804 | | 2 | 1.75 | 1.75 | 2 | 1.75 | 1.25 | 1.5 | 1 | 1.5 | 1.5 | 1.75 | 2 | 1.5 |
| 3 – HIGH, 2 – MEDIUM, 1 - LOW | | | | | | | | | | | | | | |

exam and send the award list to the CoE within the stipulated time

| CO–SDG Alignment Matrix | | | | |
|---|---|---|---|---|
| CO | CO Statement (The student should be able to…) | Relevant SDG | SDG Description | Mapping Justification |
| CO1 | review research literature, identify gaps in the literature, formulate problem, apply knowledge of mathematics, sciences, engineering fundamentals, experimental and data analysis techniques; synthesize technical knowledge and innovative approaches to generate suitable solutions for real-world complex engineering problems | SDG 13 | Industry, Innovation and Infrastructure | Research-based innovation and development of advanced ECI solutions contribute to technological progress, industrial growth, and infrastructure development. |
| CO2 | design a system or product based on product/customer specifications; develop, analyze, and critically evaluate the design alternatives in order to justify the solutions to a real-world problem guided by ethical, environmental, societal and sustainable development considerations; use modern engineering and IT tools to design, build and test a prototype within specified project timeline and budget | SDG 12 | Responsible Consumption and Production | Sustainable design practices, efficient resource utilization, and environmentally responsible engineering solutions promote responsible production and innovation. |
| CO3 | apply project management and organizational skills; demonstrate integrity, leadership, creativity, professional and ethical responsibilities as an individual and as a member or leader of a multidisciplinary team. | SDG 11 | Sustainable Cities and Communities | Collaborative development of engineering solutions addressing societal needs contributes to sustainable and resilient communities. |
| CO4 | collate the results, compare performance of prototype to design specifications and present clearly and effectively the proposed solution, conclusions and/or recommendations in written (report, poster, technical paper), oral (presentations) and multimedia formats (video pitch) and engage in self-directed independent learning and life-long learning demonstrating the KSQ of a professional engineer | SDG 4 | Quality Education | Technical communication, knowledge dissemination, and self-directed learning support continuous education and professional growth. |