# B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) with Multidisciplinary Minor

**K.E. Society's**
**Rajarambapu Institute of Technology, Rajaramnagar**
*(An Empowered Autonomous Institute, affiliated to Shivaji University, Kolhapur)*
**Curriculum Structure and Evaluation Scheme**
To be implemented for 2024-28 Batch
Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)
Rev: CSE(AI&ML) Course Structure/RIT/03/2024-28

**Class:** S. Y. B. Tech **Semester:** III

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) Max | Theory (Marks %) Min. for passing | | Practical (Marks %) Max. | Practical (Marks %) Min. for passing |
| AI201 | Discrete Mathematics | 3 | - | - | 3 | ISE | 20 | 40 | 40 | ---- | ---- |
| | | | | | | UT1 | 15 | | | ---- | ---- |
| | | | | | | UT2 | 15 | | | ---- | ---- |
| | | | | | | ESE | 50 | 40 | | ---- | ---- |
| AI203 | Data structure & Algorithms | 3 | - | - | 3 | ISE | 20 | 40 | 40 | ---- | ---- |
| | | | | | | UT1 | 15 | | | ---- | ---- |
| | | | | | | UT2 | 15 | | | ---- | ---- |
| | | | | | | ESE | 50 | 40 | | ---- | ---- |
| AI205 | Computer Organization and Architecture | 2 | - | - | 2 | ISE | 20 | 40 | 40 | ---- | ---- |
| | | | | | | UT1 | 15 | | | ---- | ---- |
| | | | | | | UT2 | 15 | | | ---- | ---- |
| | | | | | | ESE | 50 | 40 | | ---- | ---- |
| AI207 | Principles of Artificial Intelligence | 2 | - | - | 2 | ISE | 20 | 40 | 40 | ---- | ---- |
| | | | | | | UT1 | 15 | | | ---- | ---- |
| | | | | | | UT2 | 15 | | | ---- | ---- |
| | | | | | | ESE | 50 | 40 | | ---- | ---- |
| | Multidisciplinary Minor-I | 3 | - | - | 3 | ISE | 20 | 40 | 40 | ---- | ---- |
| | | | | | | UT1 | 15 | | | ---- | ---- |
| | | | | | | UT2 | 15 | | | ---- | ---- |
| | | | | | | ESE | 50 | 40 | | ---- | ---- |
| SH2174 | Environmental Science | 1 | - | 2 | 2 | ISE | 50 | 40 | 40 | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI209 | Object Oriented Programming using JAVA | 2 | - | 2 | 3 | ISE | ---- | ---- | | 50 | 50 |
| | | | | | | ESE | ---- | ---- | | 50 | 50 |
| AI211 | Data structure & Algorithms Lab | - | - | 2 | 1 | ISE | ---- | ---- | | 50 | 50 |
| | | | | | | ESE | ---- | ---- | | 50 | 50 |
| AI217 | Python Programming Lab | - | - | 2 | 1 | ISE | ---- | ---- | | 100 | 50 |
| AI219 | Version Control with Git and GitHub Lab | - | - | 2 | 1 | ISE | - | ---- | | 100 | 50 |
| | Professional Skills Development and Foreign Languages-I | - | - | 2 | 1 | ISE | - | ---- | | 100 | 50 |
| | **TOTAL** | **16** | **-** | **12** | **22** | | | | | | |
| | **TOTAL CONTACT HOURS** | **28** | | | | | | | | | |

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam
**Total Contact Hours/week : 28**
**Total Credits : 22**

| Sr. No. | Subject Name | | Course Code |
|---|---|---|---|
| 1. | Professional Skills Development and Foreign Languages | Professional Leadership Skills | SH2634 |
| 2. | | Interpersonal Skills | SH2614 |
| 3. | | Innovation Tools and Methods for Entrepreneurs | SH2694 |
| 4. | | Personal Effectiveness and Body Language | SH2594 |
| 5. | | German Language – Level III | SH2734 |
| 6. | | Japanese Language – Level III | SH2714 |

**Note:**

**1.** A student has to complete any two courses out of six choices offered under Choice Based Professional Skills Development Programme. A course in each semester will be allocated without any repetition.

**2.** Foreign Language course selected in F. Y. B. Tech Sem-I will remain the same with next levels in Sem-III & IV. (No new entries in S. Y. B. Tech Sem-III)

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**Class:** S. Y. B. Tech **Semester:** IV

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) | | | Practical (Marks %) | |
| | | | | | | | Max | Min. for passing | | Max. | Min. for passing |
| AI202 | Statistics and Fuzzy systems | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI204 | Machine Learning | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI206 | Computer Networks | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | -- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI208 | Database Management Systems | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | -- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | Multidisciplinary Minor-II | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI218 | Business Intelligence | 2 | - | - | 2 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI210 | Machine Learning Lab | - | - | 4 | 2 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| AI212 | Database Management Systems Lab | - | - | 2 | 1 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| AI220 | Desktop Publishing for Web Development | - | - | 2 | 1 | ISE | --- | --- | --- | 100 | 50 |
| AI222 | Mini Project | - | - | 2 | 1 | ISE | --- | --- | --- | 100 | 50 |
| AI226 | MOOC - I** | - | - | - | 1 | ISE | --- | --- | --- | 100 | 50 |
| | Professional Skills Development and Foreign Languages-II | - | - | 2 | 1 | ISE | --- | --- | --- | 100 | 50 |
| - | **TOTAL** | 17 | - | 12 | 24 | | | | | | |
| | **TOTAL CONTACT HOURS** | 29 | | | | | | | | | |

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam

**Total Contact Hours/week : 29**

**Total Credits : 24**

- **Note: Students are required to undergo industrial / field training of minimum two weeks in the vacation of Semester-IV and its evaluation will be carried out in the Semester-V.**
- **Note**: MOOC course certification marks will be caried out for the credits.**

| Sr. No. | Subject Name | | Course Code |
|---|---|---|---|
| 1. | Professional Skills Development and Foreign Languages | Professional Leadership Skills | SH2634 |
| 2. | | Interpersonal Skills | SH2614 |
| 3. | | Innovation Tools and Methods for Entrepreneurs | SH2694 |
| 4. | | Personal Effectiveness and Body Language | SH2594 |
| 5. | | German Language – Level IV | SH2644 |
| 6. | | Japanese Language – Level IV | SH2624 |

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**Class:** T. Y. B. Tech **Semester:** V

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) | | | Practical (Marks %) | |
| | | | | | | | Max | Min. for passing | | Max. | Min. for passing |
| AI301 | Deep Learning | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI303 | Software Engineering | 2 | - | - | 2 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Program Elective -I** | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Open Elective - I** | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | Multidisciplinary Minor-III | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | Multidisciplinary Minor-IV | 2 | - | - | 2 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI321 | Web Technology Lab | - | - | 4 | 2 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| AI313 | Deep Learning Lab | - | - | 2 | 1 | ISE | --- | --- | --- | 100 | 50 |
| AI315 | Big Data Analytics Lab | 1 | - | 2 | 2 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| AI323 | AI for Edge Devices Lab | - | - | 2 | 1 | ISE | --- | --- | --- | 100 | 50 |
| AI3191 | Summer Internship/ Professional Certification | - | - | - | 1 | ISE | --- | --- | --- | 100 | 50 |
| AI325 | MOOC-II** | - | - | - | 1 | ISE | --- | --- | --- | 100 | 50 |
| AI327 | Mini Project - I | - | - | 6 | 3 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| SH3035 | Scholastic Aptitude - I | 2* | - | - | Audit | ISE | 100 | 50 (P/NP) | --- | --- | --- |
| | **TOTAL** | **17+2*** | **-** | **16** | **27** | | | | | | |
| | **TOTAL CONTACT HOURS** | **33+2*=35*** | | | | | | | | | |

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam

**Total Contact Hours/week : 35***
**Total Credits : 27**

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- **Note*: Students should complete 5 days (30 Hours) of Scholastic Aptitude training program organized by the Institute.**
- **Note**: MOOC course certification marks will be carried out for the credits.**

## Program Elective - I

| Sr. No. | Course Code | Domain | Course |
|---|---|---|---|
| 1 | AI305 | Internet of Things | Sensor Actuated Technology |
| 2 | AI307 | Computer Vision | Computer Graphics and Vision |
| 3 | AI309 | Networking | Ad-hoc Network |
| 4 | AI311 | Natural Language Processing | Text and Speech Analysis |

## Open Elective - I

| Sr. No | Course Code | Course Name | Offered By Department |
|---|---|---|---|
| 1 | OE341 | Energy Audit and Management | Electrical Engineering |
| 2 | OE343 | Data Science | Computer Science & Engineering (Artificial Intelligence and Machine Learning) |
| 3 | OE365 | Distributed Systems | Computer Science and Information Technology |
| 4 | OE361 | Object Oriented Modeling and Design | Computer Science and Information Technology |
| 5 | OE3104 | Network Administration | Computer Science and Engineering |
| 6 | OE3381 | Disaster Management | Civil Engineering |
| 7 | OE3064 | Environmental Impact Assessment | Civil Engineering |
| 8 | OE347 | New Product Design & Development | Mechanical Engineering |
| 9 | OE349 | Non-Conventional Energy Sources | Mechanical Engineering |
| 10 | OE3044 | Renewable Energy Sources | Robotics & Automation |
| 11 | OE363 | Robotics Engineering & Applications | Robotics & Automation |
| 12 | OE353 | Factory Automation | Mechatronics Engineering |
| 13 | OE355 | Cyber Physical System | Mechatronics Engineering |
| 14 | OE357 | Internet of Things | Electronics & Telecommunication Engineering |
| 15 | OE359 | Drone Technology | Electronics & Telecommunication Engineering |
| 16 | OE351 | Hydrogen Fuel Cell Technology | Mechanical Engineering |

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**Class:** T. Y. B. Tech **Semester:** VI

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory (Marks %) | | | Practical (Marks %) | |
| | | L | T | P | Credits | Scheme | Max | Min. for passing | | Max. | Min. for passing |
| AI304 | Automata Theory | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI306 | Research Methodology | 2 | - | - | 2 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Program Elective - II** | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Open Elective - II** | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | Multidisciplinary Minor-V | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | UT1 | 15 | | | --- | --- |
| | | | | | | UT2 | 15 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI324 | Higher-Level Coding | 2 | - | - | 2 | ISE | --- | --- | --- | 100 | 50 |
| AI326 | LLM | 1 | - | 2 | 2 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| AI3181 | Mobile Application Development Lab | - | - | 2 | 1 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| AI328 | Minor Project | - | - | 12 | 6 | ISE | --- | --- | --- | 50 | 50 |
| | | | | | | ESE | --- | --- | --- | 50 | 50 |
| SH3065 | Scholastic Aptitude - II | 2* | - | - | Audit | ISE | 100 | 50 (P/ NP) | | | |
| | **TOTAL** | **17+2*** | **-** | **16** | **25** | | | | | | |
| | **TOTAL CONTACT HOURS** | **33+2*=35*** | | | | | | | | | |

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam
**Total Contact Hours/week : 35***
**Total Credits : 25**

**Note:** Students should complete 5 days (30 Hours) of Scholastic Aptitude training program organised by the institute.

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## Program Elective - II

| Sr. No. | Course Code | Domain | Course |
|---|---|---|---|
| 1 | AI308 | Internet of Things | Smart Cities |
| 2 | AI310 | Computer Vision | Augmented & Virtual Reality |
| 3 | AI312 | Networking | Wireless & Mobile Nets |
| 4 | AI314 | Natural Language Processing | Sentiment Analysis |

## Open Elective - II

| Sr. No. | Course Code | Course Name | Offered By Department |
|---|---|---|---|
| 1 | OE3084 | Material Management | Civil engineering Department |
| 2 | OE350 | Operations Research | Civil Engineering |
| 3 | OE358 | Plumbing (Water and Sanitation) | Civil Engineering |
| 4 | OE372 | Industrial Safety | Electrical Engineering |
| 5 | OE342 | Data Mining | Computer Science & Engineering (Artificial Intelligence and Machine Learning) |
| 6 | OE368 | AI for Agriculture | Computer Science & Engineering (Artificial Intelligence and Machine Learning) |
| 7 | OE3401 | Cyber Security | Computer Science and Information Technology |
| 8 | OE364 | AI for Manufacturing | Computer Science and Information Technology |
| 9 | OE348 | Information Technology Foundation Program | Computer Science and Engineering |
| 10 | OE366 | AI for Cybersecurity | Computer Science and Engineering |
| 11 | OE3284 | Supply Chain Management | Mechanical Engineering |
| 12 | OE3324 | Entrepreneurship Development | Mechanical Engineering |
| 13 | OE3024 | Reliability Engineering | Robotics & Automation |
| 14 | OE362 | Flexible Manufacturing System | Robotics & Automation |
| 15 | OE344 | Supply Chain Analytics | Mechatronics Engineering |
| 16 | OE346 | Mobile Robotics | Mechatronics Engineering |
| 17 | OE352 | Image Processing | Electronics & Telecommunication Engineering |
| 18 | OE354 | Fuzzy Logic & Neural Network | Electronics & Telecommunication Engineering |
| 19 | OE356 | Project Management | Mechanical Engineering |
| 20 | OE370 | AI for Sustainability | Electronics & Telecommunication Engineering |
| 21 | OE3242 | Marketing for Engineers | MBA |

**Class:** Final Year B. Tech **Semester:** VII

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) | | | Practical (Marks %) | |
| | | | | | | | Max | Min. for passing | | Max. | Min. for passing |
| AI401 | Social and Ethical issues in AI | 2 | - | - | 2 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | MSE | 30 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI403 | Cryptography and Network Security | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | MSE | 30 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI4051 | Cloud Computing | 2 | - | - | 2 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | MSE | 30 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| AI437 | Optimization Techniques for AI | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | MSE | 30 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Program Elective - III** | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | MSE | 30 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Program Elective - IV** | 3 | - | - | 3 | ISE | 20 | 40 | 40 | --- | --- |
| | | | | | | MSE | 30 | | | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| | **Program Elective Lab - I** | - | - | 2 | 1 | ISE | -- | --- | --- | 50 | 50 |
| | | | | | | ESE | -- | --- | --- | 50 | 50 |
| AI423 | Cloud Computing Lab | - | - | 2 | 1 | ISE | -- | --- | --- | 50 | 50 |
| | | | | | | ESE | -- | --- | --- | 50 | 50 |
| AI425 | Block chain Technologies Lab | - | - | 2 | 1 | ISE | -- | --- | --- | 50 | 50 |
| | | | | | | ESE | -- | --- | --- | 50 | 50 |
| | **TOTAL** | **16** | **-** | **6** | **19** | | | | | | |
| | **TOTAL CONTACT HOURS** | **22** | | | | | | | | | |

ISE = In Semester Evaluation, MSE = Mid Semester Exam, ESE = End Semester Exam

**Total Contact Hours/week : 22**
**Total Credits : 19**

### Program Elective-III

| Sr. No. | Course Code | Domain | Course |
|---|---|---|---|
| 1 | AI407 | Internet of Things | Intelligent Transportation System |
| 2 | AI409 | Computer Vision | Pattern Recognition |
| 3 | AI411 | Networking | Next-Generation IP Networks |
| 4 | AI413 | Natural Language Processing | Chatbot |

### Program Elective-IV

| Sr. No. | Course Code | Domain | Course |
|---|---|---|---|
| 1 | AI415 | Internet of Things | Robotics |
| 2 | AI417 | Computer Vision | Game designing |
| 3 | AI419 | Networking | Wireless Sensor Network |
| 4 | AI421 | Natural Language Processing | Natural language processing |

### Program Elective Lab- I

| Sr. No. | Course Code | Domain | Course |
|---|---|---|---|
| 1 | AI427 | Internet of Things | Robotics Lab |
| 2 | AI429 | Computer Vision | Game designing Lab |
| 3 | AI431 | Networking | Wireless Sensor Network Lab |
| 3 | AI433 | Natural Language Processing | Natural language processing Lab |

## Choice based Internship Model
## Model I: Industry Internship (II)

**Class:** Final Year B. Tech **Semester:** VIII

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) Max. | Theory (Marks %) Min. for passing | | Practical (Marks %) Max. | Practical (Marks %) Min. for passing |
| OE4382 | Finance for Engineers (Online Course) | 2 | - | - | 2 | ISE | 25 | 40 | 40 | --- | --- |
| | | | | | | ESE | 75 | 40 | | --- | --- |
| OE4362 | Engineering Management & Economics (Online Course) | 2 | - | - | 2 | ISE | 25 | 40 | 40 | --- | --- |
| | | | | | | ESE | 75 | 40 | | --- | --- |
| IP4024 | Industry Internship & Project | - | - | - | 12 | ISE | --- | ---- | | 50 | 50 |
| | | | | | | ESE | --- | --- | | 50 | 50 |
| | **TOTAL** | - | - | - | **16** | | | | | | |

ISE = In Semester Evaluation, ESE = End Semester Exam
**Total Contact Hours/week : --**
**Total Credits : 16**

**Note:**
1] Weekly Contact hours are not mentioned as student is expected to be in industry regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.

2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

**Weightage:** 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

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## Model II: Research Internship (RI)

**Class:** Final Year B. Tech **Semester:** VIII

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory (Marks %) | | | Practical (Marks %) | |
| | | L | T | P | Credits | Scheme | Max. | Min. for passing | | Max. | Min. for passing |
| OE4382 | Finance for Engineers (Online Course) | 2 | - | - | 2 | ISE | 25 | 40 | 40 | --- | --- |
| | | | | | | ESE | 75 | 40 | | --- | --- |
| OE4362 | Engineering Management & Economics (Online Course) | 2 | - | - | 2 | ISE | 25 | 40 | 40 | --- | --- |
| | | | | | | ESE | 75 | 40 | | --- | --- |
| RE4044 | Research Internship | - | - | - | 12 | ISE | --- | ---- | | 50 | 50 |
| | | | | | | ESE | --- | --- | | 50 | 50 |
| | **TOTAL** | - | - | - | **16** | | | | | | |

ISE = In Semester Evaluation, ESE = End Semester Exam
**Total Contact Hours/week : --**
**Total Credits : 16**

**Note:**
1] Weekly Contact hours are not mentioned as student is expected to be in outside research organization regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.

2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

3] Students who opt for a research internship need to undergo a minimum of one month of research internship in outside research organizations or laboratories.

**Weightage:** 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

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## Model III: Entrepreneurial Internship (EI)

**Class:** Final Year B. Tech **Semester:** VIII

| Course Code | Course | Teaching Scheme | | | Credits | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | | Scheme | Theory (Marks %) | | | Practical (Marks %) | |
| | | | | | | | Max | Min. for passing | | Max | Min. for passing |
| ED4104 | Project Management (Online Course) | 2 | - | - | 2 | ISE | 25 | 40 | 40 | - | - |
| | | | | | | ESE | 75 | 40 | | - | - |
| ED4044 | Commercial Aspects of the Project (Online Course) | 2 | - | - | 2 | ISE | 25 | 40 | 40 | - | - |
| | | | | | | ESE | 75 | 40 | | - | - |
| ED4064 | Entrepreneurship Development Program (EDP) | - | - | - | 1 | ISE | | | | 100 | 50 |
| ED4084 | Entrepreneurial Internship | - | - | - | 11 | ISE | | | | 50 | 50 |
| | | | | | | ESE | | | | 50 | |
| | | - | - | - | 16 | | | | | | |

ISE = In Semester Evaluation, ESE = End Semester Exam
**Total Contact Hours/week** : --
**Total Credits** : 16

**Note:**
1] Weekly Contact hours are not mentioned as student is expected to be in outside research organization regularly for 20 weeks. However, student needs to report to Institute mentors as and when required.

2] For online course, lecture videos of each unit will be made available through college platform to the students. For each unit there will be separate assignment. Students need to submit all assignments within specified time.

**Weightage:** 25% weightage for unit wise assignments + 75% weightage for final exam. Final exam will be held at college campus.

3] A one week Entrepreneurship Development Program (EDP) will be conducted after completion of 7th semester and before start of 8th semester.

4] Students who opt for an entrepreneurial internship need to undergo a one-month internship at an outside reputed organization or firm

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# Multidisciplinary Minor

- Students should choose any one specialization given by the department and complete all the five courses under the specialization to earn 170 Credits.
- Following are the baskets of multidisciplinary minor courses

| Multidisciplinary Minor Baskets | | | | | |
|---|---|---|---|---|---|
| **MDM Basket Name** | **Sr. No.** | **Course Code** | **Course Name** | **Semester** | **Offered by Department** |
| Construction Engineering | 1 | CEMD201 | Building Construction and Planning | III | Civil Engineering |
| | 2 | CEMD202 | Building Estimation and Valuation | IV | |
| | 3 | CEMD301 | Infrastructure Engineering | V | |
| | 4 | CEMD303 | Smart Cities and Sustainable Development | V | |
| | 5 | CEMD302 | Environmental Engineering | VI | |
| Software Programming | 1 | CSMD201 | Introduction to Data Structures | III | Computer Science & Engineering |
| | 2 | CSMD202 | Problem solving using JAVA | IV | |
| | 3 | CSMD301 | Fundamentals of Database Systems | V | |
| | 4 | CSMD303 | Object-oriented Programming in Python | V | |
| | 5 | CSMD302 | Artificial Intelligence | VI | |
| Electrical Power System | 1 | EEMD201 | Electrical Power Generation | III | Electrical Engineering |
| | 2 | EEMD202 | Power System | IV | |
| | 3 | EEMD301 | Electrical Machines | V | |
| | 4 | EEMD303 | Electrical Technology | V | |
| | 5 | EEMD302 | Smart Grid | VI | |
| Electronics System Design | 1 | ECMD201 | Electronics Devices and Applications | III | Electronics &Telecommunication Engineering |
| | 2 | ECMD202 | Electronics Communication Systems | IV | |
| | 3 | ECMD301 | Advanced Communication Systems | V | |
| | 4 | ECMD303 | Electronic Product Design | V | |
| | 5 | ECMD302 | Industrial Electronics | VI | |
| Software Development | 1 | CIMD201 | Data Structures | III | Computer Science & Information Technology |
| | 2 | CIMD202 | Computer Algorithms | IV | |

| | | | | | |
|---|---|---|---|---|---|
| | 3 | CIMD301 | Introduction to DBMS | V | |
| | 4 | CIMD303 | OOP using Java | V | |
| | 5 | CIMD302 | Software Engineering | VI | |
| Product Design and Development | 1 | MEMD203 | Design Thinking | III | Mechanical Engineering |
| | 2 | MEMD204 | Behavioral Engineering and Design | IV | |
| | 3 | MEMD305 | Product Design Tools and Techniques | V | |
| | 4 | MEMD307 | Design and Prototyping | V | |
| | 5 | MEMD304 | Marketing and Business Fundamentals for New Products | VI | |
| Mechatronics Engineering | 1 | MCMD201 | Fundamentals of Mechatronics | III | Mechatronics Engineering |
| | 2 | MCMD202 | Industrial Fluid Power | IV | |
| | 3 | MCMD301 | Sensor and Instrumentation | V | |
| | 4 | MCMD303 | Industrial Automation | V | |
| | 5 | MCMD302 | Industrial Robotics | VI | |
| Artificial Intelligence | 1 | AIMD201 | Object Oriented Programming | III | Computer Science & Engineering (AI-ML) |
| | 2 | AIMD202 | Data Structures and Algorithms | IV | |
| | 3 | AIMD301 | Machine Learning | V | |
| | 4 | AIMD303 | Business Intelligence | V | |
| | 5 | AIMD302 | Principles of AI | VI | |
| Robotics & Automation | 1 | RAMD201 | Fundamentals of Robotics & Automation | III | Robotics & Automation |
| | 2 | RAMD202 | Sensors and Actuators | IV | |
| | 3 | RAMD301 | Kinematic Dynamics for Robots | V | |
| | 4 | RAMD305 | Robot Programming | V | |
| | 5 | RAMD302 | Industrial Automation Control | VI | |

# B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) with Double Minor (Multidisciplinary and Specialization Minor)

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# Double Minor

1. It is required to complete SIX courses (each of 3 credits) from ONLINE platform to earn total of 18 credits under Double Minor (DM) certification.
2. Student must complete and earn the credits for all the six courses starting from Second Year First semester (3rd semester) to Final Year Second Semester (8th semester).
3. Basket of the DM courses and respective semester is mentioned in the following table.

| Sr. No. | Semester | Course | Code |
|---|---|---|---|
| 1 | III | DM – I | AIDM3XXX |
| 2 | IV | DM – II | AIDM4XXX |
| 3 | V | DM – III | AIDM5XXX |
| 4 | VI | DM – IV | AIDM6XXX |
| 5 | VII | DM – V | AIDM7XXX |
| 6 | VIII | DM – VI | AIDM8XXX |

4. To select course platform, first preference must be given to NPTEL.
5. Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,

a. If timeline of NPTEL course is not in line with timeline of academic calendar.
b. The suitable succeeding course in line with previous course is not available on NPTEL.
c. If any other unavoidable circumstances occur.

6. Platform and course selection must be as per recommendation of BOS of the department.
7. Student will get the credits of respective DM course in following conditions,

a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA (oral) exam.

8. While selecting online course, following points must be taken care of,

a. Selected course must be of basic or fundamental level.
b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective) or in Multidisciplinary Minor (MDM)
c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for UDEMY, COURSERA courses.

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# B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) with Honor and Multidisciplinary Minor

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# Honors with Multidisciplinary Minors

1. It is required to complete SIX courses (each of 3 credits) from ONLINE platform to earn total of 18 credits under Honor certification.
2. Student must complete and earn the credits for all the six courses starting from Second Year First semester (3rd semester) to Final Year Second Semester (8th semester).
3. Basket of the Honor courses and respective semester is mentioned in the following table.

| Sr. No. | Semester | Course | Code |
|---|---|---|---|
| 1 | III | Honor - I | AIH3XXX |
| 2 | IV | Honor - II | AIH4XXX |
| 3 | V | Honor - III | AIH5XXX |
| 4 | VI | Honor - IV | AIH6XXX |
| 5 | VII | Honor - V | AIH7XXX |
| 6 | VIII | Honor - VI | AIH8XXX |

4. To select course platform, first preference must be given to NPTEL.
5. Other than NPTEL, courses from COURSERA and UDEMY platforms are allowed to register only in following cases,

a. If timeline of NPTEL course is not in line with timeline of academic calendar.
b. The suitable succeeding course in line with previous course is not available on NPTEL.
c. If any other unavoidable circumstances occur.

6. Platform and course selection must be as per recommendation of BOS.
7. Student will get the credits of respective Honor course in following conditions,

a. In case of course selected from NPTEL platform, student have to complete the timely assignments, PASS the exam and secure the certificate.
b. In case of course selected from COURSERA or UDEMY, student have to secure the certificate and appear for VIVA (oral) exam.

8. While selecting online course, following points must be taken care of,

a. Selected course must be of advanced level and not basic or fundamental level.
b. Contents of the course should not be covered in any of the course offered in regular curriculum or not listed in any elective (open or program elective)
c. Duration of each online course must be of EIGHT weeks for NPTEL and 30+ hours for COURSERA, UDEMY courses.

# B. Tech. in Computer Science & Engineering (Artificial Intelligence and Machine Learning) - Honors with Research and Multidisciplinary Minor

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# Honors with Research and Multidisciplinary Minor

The student will work on Research Project or Dissertation for 18 Credits in the Fourth Year in respective discipline. The distribution of 18 Credits for Research project in Sem-VII and Sem-VIII is given below. To get B. Tech in Computer Science & Engineering (Artificial Intelligence and Machine Learning)-Honors with Research and Multidisciplinary Minor degree Student need to earn total 188 Credits which consist 170 credits of regular Multidisciplinary Minor courses and 18 credits of Research courses.

**Class:** Final Year B. Tech **Semester:** VII

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) | | | Practical (Marks %) | |
| | | | | | | | Max. | Min. for passing | | Max. | Min. for passing |
| REH401 | Intellectual Property Rights | - | - | - | 2 | ISE | 50 | 40 | 40 | --- | --- |
| | | | | | | ESE | 50 | 40 | | --- | --- |
| REH403 | Research project (Synopsis) phase - I | - | - | - | 2 | ISE | -- | -- | -- | 50 | 50 |
| | | | | | | ESE | -- | -- | | 50 | 50 |
| REH405 | Research Specific core course - I (Online NPTEL course) | - | - | - | 3 | ISE | 50 | 40 | 40 | -- | -- |
| | | | | | | ESE | 50 | 40 | | -- | -- |
| | **TOTAL** | - | - | - | 7 | | | | | | |

ISE = In Semester Evaluation, ESE = End Semester Exam

Note: For Evaluation of Online NPTEL course ISE Marks will be marks obtained by students in the assignments given by NPTEL, students who will secure NPTEL certification will be only eligible for ESE of the same course which will be conducted at institute

**Class:** Final Year B. Tech **Semester:** VIII

| Course Code | Course | Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Credits | Scheme | Theory (Marks %) | | | Practical (Marks %) | |
| | | | | | | | Max. | Min. for passing | | Max. | Min. for passing |
| REH402 | Research project phase - II | - | - | - | 11 | ISE | -- | -- | -- | 50 | 50 |
| | | | | | | ESE | -- | -- | | 50 | |
| | **TOTAL** | - | - | - | 11 | | | | | | |

ISE = In Semester Evaluation, ESE = End Semester Exam

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI301** | Course Name: **Deep Learning** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course covers the building blocks used in Deep Learning based solutions. Specifically, convolutional neural networks, recurrent neural networks and adversarial networks. The course also focuses on the deep architectures used for solving various Computer Vision tasks.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Demonstrate the basic concepts related to Deep learning in feed forward networks, activation function, and loss function.
2. Apply appropriate deep learning tools and optimization strategies for exploratory data analysis.
3. Analyze the results of state-of-the-art algorithms and convert the appropriate information required to solve real-world problems.
4. Demonstrate various case studies in deep learning.

**Prerequisite:**
- Machine Learning algorithms.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Neural network fundamentals: General Introduction to Deep Learning. Perceptron algorithm. Back propagation and Multi-layer Networks. Image fundamentals: Pixels, Image coordinate, scaling and aspect ratios Parameterized Learning and Optimization Methods. | 06 |
| 2. | **Parameterized Learning and Optimization Methods**<br>Parameterized Learning: Introduction to linear classification, Four components of parameterized learning, role of loss function.<br>Optimization Methods: Optimization Methods: Gradient descent. stochastic gradient descent (SGD) and extensions to SGD. Regularization. | 06 |
| 3. | **Convolutional Neural Networks (CNN)**<br>Understanding Convolutions: Convolutions versus Cross-correlation, The "Big Matrix" and "Tiny Matrix" Analogy, Kernels, A Hand Computation Example of Convolution The Role of Convolutions in Deep Learning.<br>CNN Building blocks: Layer Types, Convolutional Layers, Activation Layers, Pooling Layers, Fully-connected Layers, Batch Normalization, Dropout, ShallowNEt, LeNet, Mini VGGNET. | 06 |

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|---|---|---|
| **4.** | **Deep Learning-Based Object Detection**<br>Fundamentals of Object detection, Family of R-CNN, Single shot detectors (SSD), You only look once (YOLO). | **06** |
| **5.** | **Sequence Models**<br>Recurrent Neural Networks, Vanishing gradients, Gated Recurrent Units (GRU), Long-short-term-memories (LSTMs). | **06** |
| **6.** | **Optimization techniques & Distributed Training for DL Model**<br>Fundamentals of optimization techniques, Optimize TensorFlow; Models for Deployment with Tensor RT, Custom and Distributed Training. | **06** |

**References –**

**Text Books:**


- Ian Goodfellow Yoshua Bengio Aaron Courville, "Deep Learning", MIT Press.
- Michael Nielsen, "Neural Networks and Deep Learning", Determination Press.
- Bengio, Yoshua, "Learning deep architectures for AI",


**Reference Books:**


- N D Lewis, "Deep Learning Step by Step with Python".
- Josh Patterson, Adam Gibson, O'Reilly Media, "Deep Learning: A Practitioner's Approach,".
- Applied Deep Learning. A Case-based Approach to Understanding Deep Neural.


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| Class:- **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI303** | Course Name: **Software Engineering** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | - | - | 2 |

**Course Description:**
This course deals with various concepts of Software Engineering. It includes concepts such as software requirements, software process models, project planning, project monitoring and control, function-oriented and object-oriented design, software testing techniques and strategies. Software engineering covers the basic concepts such as data analysis, modeling and design required for developing software. The scope of the software engineering can be defined in terms of historical aspects, economicaspects, maintenance aspects, requirements, analysis and design aspects, and team development aspects.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Analyze fundamental concepts in software engineering and project management.
2. Practice software process models for the undertaken software problems.
3. Design function-oriented and object-oriented models using modern tools.
4. Compare different software testing techniques and strategies.
5. Apply the project management concepts for the undertaken software problems.
6. Illustrate concepts of project monitoring and control in software development.

**Prerequisite:**
- Fundamentals of object-oriented programming.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Software Requirements, Analysis, and Specification**<br>Software Engineering Problem and Approaches, Software requirement analysis and specification, problem analysis, Requirement Specification, Validation, Casestudy to prepare SRS. | 04 |
| 2. | **Software Process Models**<br>Waterfall model, V model, Evolutionary, Prototyping, Spiral model, Agile software development, Agile methodologies, Agile model: principle techniques, Extreme programming (XP): planning, design, coding, testing, XP practices, Scrum: framework, Sprint: product backlog, sprint backlog, burn down charts, Case study on Agile model. | 05 |
| 3. | **Function-oriented and Object-oriented Design**<br>Object Oriented Analysis and Object-Oriented Design, Object Oriented concepts, Unified Modelling Language, A Design Methodology, Design principles, module level concepts, Design notation and specification, | 05 |

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|---|---|---|
| | structured design methodology, Verification, Case study on DFD for Hospital Management System, Library Management System, Railway Reservation System and Online Shopping System. case study on Class, Object and Sequence and Collaboration diagrams for Banking system, college management system, online food ordering system. | |
| **4.** | **Software Testing Techniques and Strategies**<br>Software Testing Fundamentals, Black box testing. White box testing, Gray box testing, Unit Testing, Integration Testing, Verification & Validation, case studyon modern tools and techniques for software testing, test cases writing. | **03** |
| **5.** | **Project Planning**<br>The project planning Infrastructure: Process database, process capability baseline,process asset and the body of knowledge system, Effort estimation and scheduling. Estimation and scheduling concepts Effort estimation scheduling. Quality Planning: Quality concepts, Quantitative Quality management planning. Defect prevention planning. Risk Management: Concepts of risk and risk management assessment Risk control. | **04** |
| **6.** | **Project Managing, Monitoring and Control**<br>Processes and project management and the CMM project management process, Tanning for project managers. SEPG support to projects, Review: The Reviews. Review process, Data collection, Project tracking, milestone analysis, Monitoringand control, Defect Analysis and prevention, Project management tools: Asana, Bitrix24, Zapie. | **03** |

**References –**

**Text Books:**

- Pankaj Jalote, "Software Project Management in practice", Pearson Education.
- Pankaj Jalote, "An Integrated Approach to S/W Engineering", Narosa Publication House.

**Reference Books:**

- Roger S. Pressman, "Software Engineering - Practitioner's Approach", TATA McGraw-Hill.

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| Class:- **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI305** | Course Name: **Sensor Actuated Technology** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This Course focuses on IoT concepts such as sensing, actuation and communication. It covers the development of Internet of Things (IoT) prototypes including devices for sensing, actuation, processing, and communication—to help you develop skills and experiences.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Illustrate Key Concepts and Terminologies related to IOT.
2. Outline Raspberry Pi Programs and Arduino Programs.
3. Analyze IOT Servers and Cloud Services.
4. Evaluate IOT Solutions for real life Problems.

**Prerequisite:**
- Knowledge of Computer Networking.
- Knowledge of Microprocessor.
- Knowledge of Python and Assembly.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to IOT**<br>Introduction, Physical Design of IOT, Logical Design of IOT, Working with IOT Devices, IOT Templates, Application of IOT. | 06 |
| 2. | **Fundamentals Of IoT Mechanisms and Key Technologies**<br>Structural Aspects of IOT: Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy. IOT Technologies: RFID, Sensor, Satellite, Nano, Smart Tech, Cloud Computing. IOT Standards: Bluetooth Smart, ULE, IEEE 802.11ah, Thread, Zigbee, Zwave, 6LoWPAN, IETF IPv6 Routing Protocols for RPL Roll. | 06 |
| 3. | **Programming Raspberry Pi with Python and Arduino**<br>Introduction, Raspberry Pi Interfaces - Serial, SPI, I2C. Controlling LED, Interfacing LED and Switch, Interfacing Light Sensor (LDR) with Raspberry Pi. Arduino UNO, Sensors in Arduino Kit, Programming with Arduino. | 06 |
| 4. | **IoT Physical Servers and Cloud Offerings**<br>Introduction to Cloud Storage Models and Communication API's, WAMP-AutoBahn for IOT, Amazon Web Services for IOT, Xively Cloud Services, Django Model and Architecture, Python Web Application Framework. | 06 |

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|---|---|---|
| **5.** | **IoT And M2M**<br>Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking, Network Function Virtualization. | **06** |
| **6.** | **Case Studies Illustrating IoT Design**<br>Introduction, Home Automation- Smart Lighting, Home Intrusion Detection, Cities-Smart Parking Environment-Weather Monitoring System, Air Pollution Monitoring, Forest Fire Detection, Agriculture- Smart irrigation, Productivity Applications-IOT Printer. | **06** |

**References –**

**Text Books:**


- Yasser Ismail, "IOT- for Automated and Smart Application".
- A Bagha, "IOT- Hands on Approach".
- Fadi AI, Turjan, "Intelligence in IoT-enabled Smart Cities", CRC Press.


**Reference Books:**


- Arshdeep Bahga, Vijay Madisetti, "IOT- Hands of Approach".
- Mark Geddis, "Arduino Project Handbook".
- Fadi AI, Turjan, Muhammad Imran, "IOT Technologies in Smart Cities", IET.

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| Class:- **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI307** | Course Name: **Computer Graphics and Vision** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This comprehensive course explores the foundational principles of Color Image Processing and Computer Graphics. Students will delve into key concepts, ranging from the fundamentals of computer graphics to advanced topics such as three-dimensional graphics, moving object detection and tracking, texture analysis, and color image processing techniques. Through a balanced mix of theoretical insights and hands-on implementations, participants will gain proficiency in recognizing complex patterns, applying color models, and understanding contemporary trends in computer graphics. The course is designed to provide a holistic skill set, enabling students to effectively apply these principles across diverse domains and real-world applications.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Demonstrate Proficiency in Color Image Processing Techniques, including Color Models and Segmentation.
2. Apply 2D and 3D Graphics Algorithms for Line Drawing, Polygon Filling, and Transformations.
3. Utilize Texture Analysis Methods, including Statistical Approaches and Wavelets, for Image Understanding.
4. Integrate Object Recognition and Tracking Techniques to Identify and Monitor Objects in Image.
5. Develop a Solid Understanding of Fundamental Concepts in Color Image Processing and Computer Graphics.

**Prerequisite:**
- Fundamental Understanding of Linear Algebra and Mathematics.
- Basic knowledge of programming language.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Computer Graphics**<br>Survey of computer graphics, Overview of graphics systems- Video display devices, Raster scan systems, Random scan systems, Graphics monitors and Workstations, Input devices, Hard copy Devices, Graphics Software, Output primitives – points and lines, line drawing algorithms, Two-dimensional geometric transformations. | 06 |
| 2. | **Color Image Processing**<br>Color Fundamentals, Color models-- RGB color model - YIQ color model - | 06 |

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|---|---|---|
| | CMYcolor model - HSV color model - HLS color model, Gray level to color transformations, Basics of Color Image Processing, Color Transformations Smoothing and Sharpening, Color Segmentation. | |
| **3.** | **Three-Dimensional Graphics**<br>Three-dimensional concepts, Three-dimensional object representations– Polygonsurfaces- Polygon tables- Plane equations - Polygon meshes, Polygon surfaces, Curved Lines, and surfaces, Transformation and Viewing, Visible surface detection methods. | **06** |
| **4.** | **Moving Object Detection and Tracking**<br>Introduction, Background Modeling, Connected Component Labeling, Shadow Detection, Single Object Tracking, Discrete Kalman Filtering, Particle-filterbased tracking, Mean-shift tracking, Segmentation tracking via graph cuts. | **06** |
| **5.** | **Texture Analysis and Representation**<br>Texture Analysis- Definition, Types of texture, Texels, Approaches to texturcanalysis, Statistics, Texture descriptors – statistical, Representation-Boundary Descriptors, Regional Descriptors, Use of Principal components for description. | **06** |
| **6.** | **Object Recognition, Restoration, and 3D Vision**<br>Object Recognition-Object Detection Vs recognition, Patterns and Pattern Classes, Knowledge Representation, Statistical Pattern Recognition, Neural Nets,Restoration- Image Restoration Model, Noise Models, Restoration using spatial filtering, Reduction using frequency domain filtering, 3D Vision-Introduction to 3D imaging, applications | **06** |

**References –**

**Text Books:**


- F. S. Hill, Jr., Stephen M. Kelley, Jr., "Computer graphics using OpenGL", Pearson Prentice Hall.
- Donald D. Hearn, M. Pauline Baker, W. Carithers., "Computer Graphics with Open GL", Pearson Education,
- R. C. Gonzalez, R. E. Woods, "Digital Image Processing", PHI.
- A. K. Jain, "Fundamentals of Digital Image Processing", PHI.


**Reference Books:**


- Milan Sonka, Vaclav Hlavac, Boyle, "Digital Image Processing and Computer Vision", Cengage Learning.
- S. Jayaraman, S. Esakkirajan, T. Veerkumar, "Digital Image Processing", Tata McGrawHill.
- Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB".
- Tay Vaughan., "Multimedia: Making it Work", McGraw-Hill Education.
- Alan Watt, "3D Computer Graphics", Pearson Addison Wesley.


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| Class:- **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI309** | Course Name: **Ad-hoc Network** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course is an advanced research-oriented course designed for graduate students with computer and wireless networks background. This course examines various topics dealing with Wireless Cellular Networks and Wireless Ad hoc networks. Through this course, students can learn the state of art of wireless ad hoc networks research, and enhance their potential to do research in this exciting area. To provide more advanced in-depth networking materials to graduate students in networking research. Upon completion of this course, students willbe able to apply the materials in their networking research.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Clarify the working principles of ad-hoc wireless networks.
2. List the challenges in design of wireless ad-hoc network.
3. Analyze protocols at MAC, Routing and Transport layers of ad-hoc networks.
4. Identify security issues in designing MANET and VANET.
5. Develop ad-hoc network using physical devices like laptops, mobiles.

**Prerequisite:**
- Computer Networks.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Adhoc Networks**<br>Introduction to adhoc networks – definition, Characteristics features and applications, Issues and challenges in infrastructure-less networks. Comparison ofadhoc network with other types of existing networks like cellular network, Wired network and wireless network. | 06 |
| 2. | **MAC Protocols for Ad-hoc Wireless Networks**<br>Introduction, Problems in ad hoc channel access: Issues and need, Design goals of MAC protocol, Classification of MAC protocols: Contention based protocols, Contention-based protocols with reservation mechanisms, Contention-based protocols with scheduling mechanisms. | 06 |
| 3. | **Routing Protocols for Ad hoc Wireless Networks**<br>Introduction, Issues in designing a routing protocol for adhoc wireless networks,Classification of routing protocols, Table driven, On-demand and | 06 |

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| | hybrid routing protocols. Multicast routing. | |
| **4.** | **End to End delivery and Security**<br>Issues in designing- transport layer protocols, Classification of adhoc transport protocols, Security issues and challenges in adhoc network, Network securityattacks and secure routing protocols. | **06** |
| **5.** | **Quality of Service**<br>Introduction, issues, Challenges, Classification of QoS solutions, Mac layer solutions and network layer solutions. | **06** |
| **6.** | **Mobile Adhoc Networks (MANET) and Vehicular Adhoc Networks (VANET)**<br>Introduction, Issues in designing MANET and VANET, Advantages and challenges, Applications, Types of attacks and security issues. | **06** |

**References –**

**Text Books**


- C. S. R. Murthy & B. S. Manoj, "Ad Hoc wireless Networks – Architecture and Protocols", Pearson Education.


**Reference Books**


- O. K. Tonguz & G. Ferrari, "Ad Hoc Wireless Networks – A communication Theoreticperspective", Wiley India.
- C. K. Toh, "Ad Hoc Mobile Wireless Networks – Protocols and Systems", PearsonEducation.

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T. Y. B. Tech** | Semester- **V** |
|---|---|
| Course Code: **AI311** | Course Name: **Text and Speech Analysis** |

| L | T | P | Credits |
|---|---|---|---|
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**Course Description:**
This course provides a concise introduction to the dynamic realms of Natural Language Processing (NLP) and Speech Technology. Tailored for individuals at both beginner and intermediate proficiency levels, our primary goal is to equip students with foundational knowledge and practical competencies in the complex field of processing and comprehending human language. Throughout this learning journey, participants will explore the basics of NLP, delve into classification algorithms for text documents, and master the development of question-answering and dialogue systems. Join us in this educational endeavor to gain a comprehensive understanding of the fundamental principles and applications within the exciting domains of NLP and Speech Technology.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Evaluate existing and emerging deep learning architectures for text and speech processing.
2. Analyze deep learning techniques for NLP tasks, language modeling, and machine translation.
3. Utilize coreference and coherence for text processing.
4. Build question-answeringsystems, chatbots, and dialogue systems.
5. Apply deep learning models for building speech recognition and text-to-speech systems.

**Prerequisite:**
- Basic understanding of machine learning concepts.
- Basic knowledge of Python programming.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Natural Language Basics**<br>Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model. | 07 |
| 2. | **Text Classification**<br>Vector Semantics and Embeddings -Word Embeddings - Word2Vec model –Glove model – FastText model – Overview of Deep Learning models – RNN –Transformers – Overview of Text summarization and Topic Models. | 07 |

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| **3.** | **Question Answering System**<br>Information retrieval – IR-based question answering – knowledge-based questionanswering – language models for QA – classic QA models. | **05** |
| **4.** | **Dialogue Systems**<br>Chatbots – Design of dialogue systems – evaluating dialogue systems. | **05** |
| **5.** | **Text-To-Speech Synthesis**<br>Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet, and other deep learning-based TTS systems. | **06** |
| **6.** | **Automatic Speech Recognition**<br>Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems. | **06** |

**References –**

**Text Books:**


- Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition".


**Reference Books:**


- Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to GainingActionable insights from your data", A Press, Miroslav, Kubat.
- Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press.
- Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition", Pearson.
- Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.


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| Class:- **T.Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **OE341** | Course Name: **Energy Audit and Management** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | – | 3 |

**Course Description:**
This course provides basic understanding of energy audit and management. Essential theoretical and practical knowledge about the concept of energy conservation, energy management, and different approaches of energy conservation in industries, economic aspects of energy conservation project and energy audit and measuring instruments in the commercial and industrial sector will be achieved through this course.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Identify the important of Energy Scenario.
2. Use energy audit knowledge to carry out energy audit of a given firm.
3. Examine different rolls in energy action planning
4. Apply project finance and management skills to carry out energy audit
5. Plan for energy monitoring and targeting.

**Prerequisite:** Electric Machines, Thermal Systems and Finance Management

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Energy Scenario**<br>Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and Environment, Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features. AI applications in energy sector | 06 |
| 2. | **Energy Management and Audit**<br>Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments, suitable case study for energy audit. | 06 |
| 3. | **Energy Action Planning**<br>Key elements, Force field analysis, Energy policy purpose, perspective, Contents, Formulation, Ratification, Organizing –location of energy management, Top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivating-motivation of employees: Information system-designing barriers, Strategies; Marketing and communicating-training and planning. | 06 |

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| **4.** | **Financial Management**<br>Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs | **06** |
| **5.** | **Project Management**<br>Definition and scope of project, Technical design, Financing, Contracting, Implementation and performance monitoring. Implementation plan for top management, Planning Budget, Procurement Procedures, Construction, Measurement & Verification | **06** |
| **6.** | **Energy Monitoring and Targeting**<br>Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM). Suitable case study. | **06** |

**References –**

**Text Books:**

- Amit Kumar Tyagi, Handbook on Energy Audits and Management, TERI Publication.
- Wayne C. Turner, Energy Management Handbook, Wiley Inter Science Publication.

**Reference Books:**

- P. O'Callaghan, Energy Management, McGraw - Hill Book Company.
- Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I.

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| Class:- **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **OE343** | Course Name: **Data Science** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
The course helps to learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration. The orientation of course is to understand the basic types of data and basic statistics. The organization of data inline to Vectors, Matrices and Frames are examined. The Conditionals and Control Flow of data over R programming is to be implemented. Additionally, it will assist in identifying the importance of data reduction and data visualization techniques.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Articulate basic terms what Statistical Inference means.
2. Analyze the data using various statistical measures.
3. Identify data organization techniques used as foundations for modelling data.
4. Utilize R elements for data handling.
5. Perform data reduction and apply visualization techniques.

**Prerequisite:** Basic Mathematics, Descriptive statistical techniques

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Definition of Data Science- Big Data and Data Science hype – and getting past the hype - Datafication - Current landscape of perspectives - Statistical Inference - Populations and samples - Statistical modeling, probability distributions, Basics of R programming. | 06 |
| 2. | **Data Types**<br>Types of Data: Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. | 06 |

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|---|---|---|
| **3.** | **Statistical Description of Data**<br>Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data. | **06** |
| **4.** | **Data Organization**<br>Vectors: Creating and Naming Vectors, Vector Arithmetic, Matrices: Creating and Naming Matrices, Matrix Sub setting, Arrays, Factors and Data Frames: Introduction to Factors, Factor Levels, Summarizing a Factor, Introduction to Data Frame. | **06** |
| **5.** | **Conditionals and Control Flow**<br>Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements. Iterative Programming in R, Functions in R. | **06** |
| **6.** | **Data Reduction and Visualization**<br>Overview of Data Reduction Strategies, Principal Components Analysis, Attribute Subset Selection, Data Cube Aggregation. Data Visualization: Pixel - Oriented, Visualization Techniques. | **06** |

**References –**

**Text Books:**


- Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly
- Jiawei Han, Micheline Kamber and Jian Pei., "Data Mining: Concepts and Techniques", The Morgan Kaufmann Series in Data Management Systems
- K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.


**Reference Books:**


- Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", Pearson Education
- Brain S. Everitt, "A Handbook of Statistical Analysis Using R", 4 LLC
- Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media
- Paul Teetor, "R Cookbook", O'Reilly


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| Class:- **T.Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **OE365** | Course Name: **Distributed Systems** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | – | 3 |

**Course Description:**
This course provides elementary introduction to fundamental concepts and principles of distributed systems. It elaborates the architecture, design, and implementation of distributed systems, emphasizing resource sharing, coordination, and communication among networked computers. The course covers system models, networking principles, operating system support, web services, and distributed file systems. It makes students aware about the complexities and challenges involved in designing and managing distributed systems.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Describe the basic principles and characteristics of distributed systems.
2. Explain different models of distributed systems and understand their applications.
3. Apply fundamental networking principles and Analyze internet protocols.
4. Comprehend the role of operating systems in supporting distributed systems, including processes, threads, communication, and virtualization.
5. Develop and secure web services for distributed applications.
6. Analyze distributed file system architecture.

**Prerequisite:** Basics of Computer Networks

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Characterization of Distributed Systems** Introduction to distributed system, Examples of distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges. | 04 |
| 2. | **System Model** Introduction, Physical models, Architectural models – Client-Server model, Peer-to-Peer model, Layered Model, Micro-services Model, Fundamental models – Interaction Model, Remote Procedure Call, Security Model. | 06 |
| 3. | **Networking and Internetworking** Introduction, Types of networks, Network principles, Internet protocols, Case studies: Ethernet, WiFi and Bluetooth. | 06 |
| 4. | **Operating System Support** Introduction, Operating system layer, Protection, Processes and threads, Communication and invocation, Operating system architecture, Virtualization at the operating system level. | 07 |

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| **5.** | **Web Services**<br>Web services, Service descriptions and IDL for web services, A directory service for use with web services, XML security, Coordination of web services, Applications of web services. | **07** |
| **6.** | **Distributed File System**<br>Introduction, Features of DFS, File service architecture, Applications of DFS, Case study: Sun Network File System, Case study: The Andrew File System, Enhancements and further developments. | **06** |

**References -**

**Text Books:**

- George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, "Distributed Systems Concepts and Design", Pearson.

**Reference Books:**

- Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems: Principles and Paradigms", Pearson.

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| Class:- **T.Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **OE361** | Course Name: **Object Oriented Modeling and Design** |

| L | T | P | Credits |
|---|---|---|---|
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**Course Description:**
This course introduces students to the design of software models by the ways of expressing some sort of abstract language or diagrams are used to express the software design. Software analysis and design includes all activities, which help the transformation of requirement specification into implementation. Requirement specifications specify all functional and non-functional expectations from the software. These requirement specifications come in the shape of human readable and understandable diagrams. Object-oriented software design, an object modeling language such as UML is used to develop and express the software design. UML is a standard language for specifying, visualizing, constructing, and documenting the artifacts of software systems.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Identify object classes and build the domain model using advanced concepts in object, dynamic and functional modeling.
2. Apply different object-oriented design techniques.
3. Design models using UML diagrams for software systems: use case, class, sequence, collaboration, activity, state chart diagrams, component and deployment.
4. Design software systems using open source and advanced modeling tools.
5. Evaluate designs of software systems in mini-projects, projects using Software Modeling & Design concepts.

**Prerequisite:** Basic knowledge of Software Engineering and object oriented programming.

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction to Object Modeling**<br>Object Oriented development & themes, Modeling as a Design Technique, Objects, classes, links and associations, generalization and inheritance, Aggregation, abstract classes, generalization as extension and restriction, multiple inheritance, metadata, candidate keys and inheritance. | **06** |
| **2.** | **Dynamic & Functional Modeling**<br>Events, states, operations, concurrency, nested state diagrams, advanced dynamic modeling concepts, DFD, Case Study to draw nested state diagrams, Dynamic diagrams and DFD using UML tools. | **06** |
| **3.** | **Design Methodology** | **06** |

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|---|---|---|
| | Preview of OMT technology, Impact of an object oriented approach, Analysis, System design with examples, combining models, Designing models, Comparing Methodologies using structured analysis and design. | |
| **4.** | **Structural Modeling using UML**<br>Classes, Relationships, Common mechanisms. Diagrams, Class Diagrams, Interfaces, Types and Roles, Packages, Instances and Object Diagram, Case Study on class and object diagrams. | **06** |
| **5.** | **Behavioral Modeling using UML**<br>Interactions, Use cases, Use case diagram, Interaction Diagrams and Activity diagrams, Events and signals, State Machines, Processes and Threads, Time and space, State chart diagrams, Case Study on use case, interaction, activity and state chart diagrams. | **06** |
| **6.** | **Architectural Modeling using UML: -** Components, Deployment, Collaboration, Patterns and Frame works, Component diagrams and Deployment Diagrams, Case Study on Components, Deployment, Collaboration diagrams. | **06** |

**References –**

**Text Books:**


- Michael Blaha, James R. Rumbaugh, William Premerlani, James Rumbaugh, "Object-Oriented Modeling and Design with UML" Pearson.
- Grady Booch, Jeams Rambaugh, Ivar Jacotson, "The Unified Modeling Language User Guide", Pearson.


**Reference Books:**


- Andrew High, "Object Oriented Analysis and Design", McGraw Hill Education.
- Mark Priestley, "Practical Object Oriented Design with UML", McGraw-Hill Education.


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| Class:- **T.Y. B.Tech** | Semester- **V** |
|---|---|
| Course Code: **OE3104** | Course Name: **Network Administration** |

| L | T | P | Credits |
|---|---|---|---|
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**Course Description:**
This course introduces the fundamental concepts of computer networks and network administration for students from non-software engineering disciplines. It covers essential networking concepts, network devices, IP addressing, basic network configuration, security, troubleshooting, and network monitoring to help students understand the role of networking in modern industrial and organizational environments.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Explain the fundamental concepts of computer networking and their applications in industrial and organizational environments.
2. Apply IP addressing techniques and perform basic network configuration for connected systems and devices.
3. Demonstrate the configuration and management of common networking devices such as switches, routers, and wireless access points.
4. Analyze basic network security measures and safe communication practices in networked systems.
5. Evaluate and troubleshoot small-scale networks to ensure proper maintenance, connectivity, and security using standard networking practices.

**Prerequisite:**
Basic knowledge of computer fundamentals, Familiarity with internet usage and computer hardware.

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| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction to Computer Networks**<br>Introduction to Computer Networks, Importance of Networking in Industrial and Organizational Applications, Types of Networks (LAN, MAN, WAN), Network Topologies, Basics of OSI and TCP/IP Models, Network Devices – Hub, Switch, Router, Bridge, Gateway, Introduction to Transmission Media (Guided and Unguided) | **06** |
| **2.** | **IP Addressing and Network Configuration**<br>Basics of IPv4 Addressing, Introduction to Subnetting, Private and Public IP Addresses, DHCP and DNS Concepts, Basic Network Configuration in Windows and Linux Systems. | **06** |
| **3.** | **Network Devices and Wireless Communication**<br>Introduction to VLAN Concepts, Routing Basics, Wireless Networks, Wi-Fi Standards, Wireless Access Points and their Applications in Industrial and Office Environments, Mobile and Cellular Networks (GSM, CDMA). | **06** |
| **4.** | **Network Setup and Administration**<br>Role of Network Administration in Organizations, Basic Network Installation and Setup, User and Resource Management, File and Print Sharing Services, Introduction to Network Monitoring Tools, Backup and Recovery Concepts. | **06** |
| **5.** | **Basics of Network Security**<br>Fundamentals of Network Security, Common Network Threats and Attacks, Basics of Firewall Configuration, VPN Concepts, Password Policies and Access Control Mechanisms. | **06** |
| **6.** | **Network Troubleshooting and Maintenance Practices**<br>Basics of Network Troubleshooting, Common Connectivity Problems, Diagnostic Tools (Ping, Traceroute, Netstat, IPConfig), Introduction to Performance Monitoring, Network Documentation, Maintenance Practices and Safety Considerations. | **06** |

**References –**

**Text Books:**


- Computer Networks – Andrew S. Tanenbaum, Pearson Education.
- Networking All-in-One For Dummies – Doug Lowe, Wiley.


**Reference Books:**


- Data Communications and Networking – Behrouz A. Forouzan, McGraw Hill.
- Network+ Guide to Networks – Jill West, Cengage Learning.
- Network Security Essentials – William Stallings, Pearson.

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| Class: **T. Y. B. Tech.** | Semester: **V** |
|---|---|
| Course Code: **OE3381** | Course Name: **Disaster Management** |

| L | T | P | Credits |
|---|---|---|---|
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**Course Description:**
This course provides a holistic understanding of disaster management, covering both natural and manmade disasters. Students will delve into the meaning, nature, and various types of disasters, exploring their effects on individuals, communities, and the environment. The course encompasses a global perspective while focusing on the disaster profile of India, considering regional and seasonal variations.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Outline disaster and disaster management cycle.
2. Summarize disaster preparedness and response activities for various types of disaster.
3. Apply various advanced techniques for disaster management.
4. Examine role of various agencies in disaster management.
5. Analyze the disaster management scenario in India.

**Prerequisite:** Environmental Science

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Natural Disaster**<br>Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic, eruptions, Heat and cold Waves, Climatic Change: Global waning, Sea Level rise, Ozone Depletion. | 06 |
| 2. | **Manmade Disasters**<br>Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disasters -A Global View, Disaster Profile of India- Regional, and Seasonal. | 06 |
| 3. | **Disaster management cycle**<br>Introduction to Disaster Management Cycle: Mitigation, Preparedness, Response and Recovery. Disaster Mitigation, Hazard identification and vulnerability analysis, Mitigation strategies or measures. | 06 |
| 4. | **Disaster Preparedness, Response and Recovery**<br>Introduction to Disaster Preparedness, Disaster Risk Reduction (DRR), The Emergency Operation Plan (EOP). Introduction to Disaster Response, Aims | 06 |

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| | of disaster response, Disaster. Response Activities, Modern and traditional responses to disasters, Modern methods of disaster response, Disaster Recovery, The Recovery Plan, Disasters as opportunities for development initiatives. | |
| **5.** | **Role of technology in Disaster management**<br>Geographic Information System (GIS) and Disaster Management. GIS applications. Global Positioning System (GPS) and Disaster Management, Applications of GPS to Disaster management. Remote Sensing and its significance in Disaster Management. | **06** |
| **6.** | **Role of Multiple Stakeholders in Disaster management**<br>Role of NGO's, Community based organizations, media, Central, State, District and Local Administration, armed forces, Police and other organizations. | **06** |

**References:**

**Codes of Practice:**


- National Disaster Management Authority (NDMA). National Disaster Management Plan 2019.
- National Disaster Management Authority (NDMA). National Disaster Management Act 2005.


**Text Books:**


- Coppola, D. P. "Introduction to International Disaster Management", Elsevier USA.
- Singh R. B., "Disaster Management", Rawat Publication.


**Reference Books:**


- Reiter L., "Earthquake Hazard Analysis: Issues and Insight", Colombia University Press.
- Mileti D. S. "Disaster by Design: A Reassessment of National Hazards in United States", The National Academic Press.


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| Class: **T. Y. B. Tech.** | Semester: **V** |
|---|---|
| Course Code: **OE3064** | Course Name: **Environmental Impact Assessment** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
Environmental impact assessment (EIA) is offered as open Elective for Undergraduate course (B. Tech) semester V. It deals with definitions and concepts, rationale and historical development of EIA, EIA in Engineering, Initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Apply EIA methods to prepare a report.
2. Analyse the all projects by using Environmental Impact assessment tool.
3. Provide solution for decision making in Industrial Development Problem.
4. Prepare EIA report for submission to concerned authority.

**Prerequisite:** Possess basic knowledge of Environmental Science

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Basic concepts of EIA**<br>Environmental Impact Assessment: Introduction, Stages of EIA, Origin of EIA, Establishments of Procedure: Legislative Option, Project Screening for EIA, Methods, Projects thresholds, Sensitive area criteria Matrices. Scope studies for Environmental Impact Studies (EIS). Preparation for EIS Planning, Public Participation and Review of EIS. | |
| **2.** | **Methods for impact assessment**<br>Background information, interaction matrix methodologies, network methodologies, mathematical modelling, environmental setting, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment. | 06 |
| **3.** | **Prediction and assessment of impact for air and noise environment**<br>Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations. | 06 |

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|---|---|---|
| **4.** | **Prediction and assessment of impact for water and soil environment**<br>Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations. | 06 |
| **5.** | **Prediction and assessment of impact on cultural and socioeconomic environment**<br>Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation. | 06 |
| **6.** | **AI applications Decision Methods for Evaluation of Alternative**<br>Categorization of Industries for seeking environmental clearance from concerned authorities, AI tools like Bayesian network, SCREENER, Calyx tm, ORBI, IMPACT, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring. | 06 |

**References:**

**Text Books:**


- Canter R.L., Environmental Impact Assessment, McGraw Hill International Edition.
- John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.


**Reference Books:**


- R.R Barthwal, Environmental Impact Assessment, New Age International Publishers
- Abbasi, Environmental Impact Assessment, McGraw Hill International Edition.


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| Class:- **T.Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **OE347** | Course Name: **New Product Design and Development** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | -- | 3 |

**Course Description:**
Maximizing the success of new products and services can drive growth and shareholder value, lead to significant competitive advantage and leapfrog a company ahead of its competitors. However, innovation is risky and most new products fail in the marketplace. Often, failure is due to an ineffective process. Thus, expertise in the design and marketing of new products is a critical skill for all managers, inside and outside of the marketing department. In this course, we first focus on the tools and techniques associated with analyzing market opportunities and then focus on designing, testing, and introducing new products and services. This course will introduce the new product development process and cover the three main areas of focus:

- Discovery - opportunity identification
- Design - concept and product design, development and evaluation
- Delivery - innovative approaches to product launch and introduction.

**Course Learning Outcomes:**
This course is designed to familiarize students with the principles and practices in the development, design, Development and introduction of new products and services. After successful completion of the course, student will be able to:

1. Identify the new product opportunities and sources of new product ideas.
2. Elaborate the product life cycle and product design process.
3. Integrate the customer and end-consumer needs into design process.
4. Apply the concepts and tools like DFMA, VE and QFD in design process
5. Assimilate the various product characteristics to design a novel product
6. Participate in group work sessions and teams to become acquainted with the importance of teamwork and collaboration that is critical to new product success.

**Prerequisite:** Course is open to all Students. The course demands application of creativity, sensitivity towards solving problems and liking for doing something new and creative.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Discovery- Opportunity identification for new products**<br>Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas, S curves and technology forecasting. Product idea generation, Product Design Process steps, creativity and innovation. | 06 |
| 2. | **Identifying Customer Needs** | 06 |

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|---|---|---|
| | Understanding customer needs, Voice of the customer, Gathering customer needs, Design Thinking (organizing and prioritizing needs), Product mission statement, Benchmarking and establishing product specifications | |
| **3.** | **Product Concept Generation, Selection and Testing**<br>Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods. Product Architecture-types, establishing architecture, Modular design. Prototyping. | **06** |
| **4.** | **Product Design Tools and Techniques**<br>Design for manufacturing and assembly (DFMA), Product teardown and experimentation, Concurrent engineering, Quality function Deployment (QFD), Value engineering. | **06** |
| **5.** | **Product Idealization:**<br>Basic elements: Line, texture, color, form, symmetry, balance, scale, mass, unity and variety. Concept of visual language and visual design. Negative space. Use of symmetry. Generation of patterns and textures using simple elements. Color, color combinations and its dimensions: hue, value and Chroma. Color meanings in traditions and psychological use of colors. Ergonomic considerations, Anthropometry. | **06** |
| **6.** | **Product Takeoff and Market Entry**<br>Economic analysis, life- cycle costing, sensitivity analysis Pricing, Packaging, Preparing a launch plan, Pricing and Marketing. Intellectual property rights (IPR). | **06** |

**References: -**

**Text Books:**


- Ulrich, Eppinger, Anita Goel, Product Design and Development, McGraw Hill Publishing.
- Otto & wood, Product Design, Pearson Education, reprint.


**Reference Books:**


- Devdas Shetty, Design for product success, Society for Manufacturing Engineering.
- Charles Flurscheim, Industrial Design in Engineering, the Design Council, London.


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| Class:- **T.Y. B. Tech** | Semester-**V** |
|---|---|
| Course Code: **OE349** | Course Name: **Non-conventional Energy Sources** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | – | 3 |

**Course Description:**
This course provides a comprehensive understanding of non-conventional or renewable energy sources, exploring the principles, technologies, and applications associated with harnessing sustainable energy. The focus is on alternative sources that are environmentally friendly and contribute to reducing dependence on conventional fossil fuels. Students will delve into the latest advancements, challenges, and opportunities in the field of non-conventional energy.

**Course Learning Outcomes:**
At the end of the course the student should be able to:
1. Identify the need of requirement of renewable energy source
2. Summarize the various available energy sources.
3. Illustrate different technologies essential for conversion of renewable energy sources.
4. Evaluate the performance of energy conversion systems for maximum efficiency
5. Compare the various renewable energy technologies.
6. Select appropriate renewable energy technology for specific application

**Prerequisite:**Nil

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Basics of Energy Sources**<br>World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilization – Renewable Energy Scenario in India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems. | 06 |
| 2. | **Solar Energy**<br>Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications. | 06 |
| 3. | **Bio - Energy**<br>Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications. | 06 |
| 4. | **Wind Energy** | 06 |

| | | |
|---|---|---|
| | Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects. | |
| **5.** | **Hydrogen Energy**<br>Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation, utilization of hydrogen gas, hydrogen as alternative fuel for vehicles. Design principle and operation of fuel cell, Types of fuel cells, conversion efficiency of fuel cell, and application of fuel cells. | **06** |
| **6.** | **Other Renewable Energy Sources**<br>Tidal energy, Wave Energy – Open and Closed OTEC Cycles, Small Hydro-Geothermal Energy, Stored hydro energy, Principles of hydro power technology. | **06** |

**References: -**

**Text Books:**


- S P Sukhatme, Solar Energy, McGraw Hill Education
- G.D. Rai, Non-conventional energy sources, Khanna Publishers, New Delhi
- John Twidell, Renewable Energy Resources, Routledge


**References:**


- Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press, U.K.
- Freris. L.L., Wind Energy Conversion Systems, Prentice Hall, UK
- David M. Mousdale, Introduction to Biofuels, CRC Press, Taylor & Francis Group, USA,
- B. H. Khan, Non-Conventional Energy, Tata McGraw-Hill, New Delhi,

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| Class: T.Y. B.Tech. | Semester-V |
|---|---|
| **Course Code: OE3044** | Course Name: **Renewable Energy Sources** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course provides a comprehensive introduction to various renewable energy sources, including solar, wind, biomass, hydro, geothermal, and emerging technologies. It explores the fundamental principles, working mechanisms, and applications of these energy sources while emphasizing their role in sustainable development. Students will gain insights into energy storage solutions, smart grids, and the latest advancements in renewable energy integration. The course also covers environmental impacts, economic feasibility, and government policies promoting clean energy adoption. By the end of this course, students will be equipped with the knowledge to contribute to the development and implementation of renewable energy solutions in real-world scenarios.

**Course Outcomes:**
After successful completion of the course, students will be able to-

1. Explain fundamental knowledge of various renewable energy sources and their importance.
2. Describe the working principles, technologies, and applications of renewable energy systems.
3. Analyze the environmental impact and economic feasibility of renewable energy solutions.
4. Investigate recent advancements and future trends in sustainable energy technologies.

**Prerequisite:** Engineering Physics, Engineering Chemistry, Basics of Mechanical Engineering

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Renewable Energy**<br>Overview of global and national energy scenarios, Need for renewable energy and sustainability, Comparison of renewable and non-renewable energy sources, Government policies and incentives for renewable energy adoption. | 06 |
| 2. | **Solar Energy Systems**<br>Basics of solar radiation and measurement, Photovoltaic (PV) systems: Types, working principles, and efficiency, Solar thermal systems: Collectors, solar water heaters, and solar concentrators, Applications of solar energy: Power generation, desalination, and space heating, solar energy prediction models. | 06 |

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|---|---|---|
| **3.** | **Wind Energy Systems**<br>Fundamentals of wind energy and wind power generation, Wind turbine types, aerodynamics, and power extraction, Wind farm planning, site selection, and grid integration, Challenges and advancements in wind energy technology, efficiency, wind energy prediction models. | **06** |
| **4.** | **Biomass and Bioenergy**<br>Biomass resources and their classification, Conversion technologies: Combustion, gasification, and biogas production, Biofuels: Biodiesel, bioethanol, and their applications, Waste-to-energy technologies and environmental benefits. | **06** |
| **5.** | **Hydropower and Geothermal Energy**<br>Principles of hydroelectric power generation, Classification of hydro plants: Small, medium, and large-scale hydropower, Geothermal energy sources and power generation techniques, Direct-use applications of geothermal energy. | **06** |
| **6.** | **Emerging Renewable Technologies and Energy Storage**<br>Ocean energy: Tidal, wave, and ocean thermal energy conversion (OTEC), Hydrogen as a renewable fuel: Production, storage, and fuel cells, Energy storage technologies: Batteries, flywheels, and pumped hydro storage, compressed air, Smart grids and future trends in renewable energy integration. | **06** |

**References –**

**Text Books:**


- Rai G. D. Non-Conventional Energy Sources, Khanna Publishers.
- Boyle G. Renewable Energy: Power for a Sustainable Future, Oxford University Press.
- Sukhatme, S. P., Nayak, J. K. – Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill.


**Reference Books:**


- Twidell, J., Weir, T. – Renewable Energy Resources, Taylor & Francis.
- Duffie, J. A., Beckman, W. A. – Solar Engineering of Thermal Processes, Wiley.
- Godfrey, B. – Wind Energy Handbook, Wiley.
- Sorensen, B. – Renewable Energy: Physics, Engineering, Environmental Impacts, Economics & Planning.


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| Class: **T.Y. B.Tech.** | Semester-V |
|---|---|
| Course Code: **OE363** | Course Name: **Robotics Engineering & Applications** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course explores the practical applications of robotics in various industries, including manufacturing, healthcare, agriculture, defense, and space exploration. It provides an understanding of robotic systems, sensors, actuators, and AI-driven automation. Students will learn about industrial robots, service robots, autonomous systems, and emerging trends in robotics. The course emphasizes real-world case studies, ethical considerations, and the impact of robotics on society, preparing students for careers in robotics and automation.

**Course Outcomes:**
After successful completion of the course, students will be able to-
1. Explain various applications of robotics in industry and society.
2. Describe the concept of automation, robot integration, and their role in Industry 4.0.
3. Investigate the use of robots in healthcare, agriculture, defence, service, and space exploration.
4. Discuss ethical considerations and future trends in robotics applications.

**Prerequisite:** Basics of Mechanical Engineering, Basics of Robotics and automation, sensors and Actuators, Control System

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Robotics in Agriculture**<br>Introduction, historical development, Autonomous tractors, drones, and harvesting robots, impact and sustainability of agricultural robots, artificial intelligence and machine learning in agricultural robotics | 6 |
| 2. | **Industrial Robotics and Manufacturing Applications**<br>Use of robots in manufacturing and assembly lines, Robotics in material handling, welding, painting, and packaging, Integration of robots with CNC machines and flexible manufacturing systems (FMS), Industry 4.0 and smart factories: Role of IoT, AI, and digital twins. | 6 |
| 3. | **Robotics in Healthcare and Medical Applications**<br>Robotics in surgery, rehabilitation, and prosthetics, Assistive robots for elderly and disabled individuals, Role of AI in robotic healthcare applications, Case studies on robotic-assisted surgery (e.g., Da Vinci Surgical System). | 6 |
| 4. | **Robotics in Défense, and Space Exploration** | 6 |

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|---|---|---|
| | Military robots: Unmanned ground vehicles (UGVs), aerial drones (UAVs), and bomb disposal robots, Robotics in space exploration: Rovers, robotic arms, and satellite servicing, Challenges and advancements in space robotics. | |
| **5.** | **Service, Autonomous, and Humanoid Robotics**<br>Service robots: Household, hospitality, and customer service applications, Autonomous robots: Self-driving cars, warehouse automation, and logistics, Humanoid robots and their interaction with humans, Ethical concerns and the impact of robotics on employment, Case Study of Humanoid Robots (Rashmi, Sofiya, Yashnee etc) | **6** |
| **6.** | **Future Trends, Challenges, and Ethical Considerations**<br>Soft robotics and bio-inspired robots, AI and machine learning in robotics, cybersecurity risks and ethical considerations in robotics applications, robo grammer and robo romi, Future challenges and opportunities in robotics engineering. | **6** |

**References –**

**Text Books:**


- Spong, M. W., Hutchinson, S., Vidyasagar, M. – Robot Modeling and Control,Wiley
- Mukherjee, S. – Robotics and Automation Engineering, Oxford University Press.
- Mittal, R. K., Nagrath, I. J. – Robotics and Control, Tata McGraw-Hill.
- Rajput, R. K. – Robotics and Industrial Automation, S. Chand Publishing.


**Reference Books:**


- Groover, M. P. – Industrial Robotics: Technology, Programming, and Applications, McGraw-Hill.
- Siciliano, B., Khatib, O. – Springer Handbook of Robotics, Springer.
- Craig, J. J. – Introduction to Robotics: Mechanics and Control, Pearson.

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| Class:- **T.Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **OE353** | Course Name: **Factory Automation** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | -- | 3 |

**Course Description:**
To provide a clear view on factory automation types & to learn the various methods involved in automatic control and monitoring & to familiarize with factory automation systems in manufacturing and process industry.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Recognize various automation technologies in manufacturing and process industries.
2. Select various automation tools and methods in the manufacturing industry.
3. Implement various control and automation methods in process industries.
4. Analyze automation systems for manufacturing and process industries.

**Prerequisite:** Manufacturing systems, sensors and actuators,

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Introduction: Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automation. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. | 06 |
| 2. | **Material Handling and Identification Technologies**<br>Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods. | 06 |
| 3. | **Automated Manufacturing Systems**<br>Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation. Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. | 06 |
| 4. | **Control Technologies in Automation**<br>Industrial Control Systems, Process Industries versus Discrete Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. | 06 |
| 5. | **Computer Based Industrial Control** | 06 |

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|---|---|---|
| | Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems& RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems. | |
| **6.** | **Case Study**<br>Factory automation in manufacturing industry and Process Industry. | **06** |

**References –**

**Reference Books:**


- Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover, Pearson Education.
- Computer Based Industrial Control- Krishna Kant, EEE-PHI.
- An Introduction to Automated Process Planning Systems- Tiess Chiu Chang &Richard A.Wysk
- Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi.
- Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, ISA Publication.
- Bolton, "Programmable Logic Controllers" Newnes.


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| Class: - **T.Y. B. Tech** | Semester- **V** |
|---|---|
| Course Code: **OE355** | Course Name: **Cyber Physical Systems** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
To study the basic concepts, requirements, principles, and techniques in emerging cyber-physical systems. Provide students hands-on experience in prototyping a cyber-physical system. Address real-world problems through Cyber Physical Systems. The objective of this course is to develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective. The course also aims to provide students of different disciplinary background with necessary knowledge to understand the fundamentals of cyber physical systems.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Understand the need and purpose of the different components of CPS.
2. Design physical system depends on its requirements.
3. Develop the ability to interact with cyber-physical systems protocols.
4. Analyze common methods used to secure cyber-physical systems.

**Prerequisite:** -NA-

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Computational foundation of Cyber Physical Systems** Cyber Physical Systems in Real world, Basic Principle of Cyber Physical Systems, Industry 4.0, IIoT. Introduction Toward Industry 5.0: Cognitive Cyber-Physical System | 06 |
| 2. | **Cyber Physical System Design** Cyber Physical Systems Design Recommendations, CPS system requirements, Cyber Physical System Application, Case study of Cyber Physical Systems. | 06 |
| 3. | **Cyber Physical System Platforms & Models** Hardware platforms for Cyber Physical Systems (Sensors/Actuators, Microprocessor/Microcontrollers), Wireless Technologies for Cyber Physical Systems. | 06 |
| 4. | **Cyber Physical System – Models and Dynamics Behaviors** Continuous Dynamics, Discrete dynamics, Hybrid Systems | 06 |
| 5. | **Concurrent Models of computation** Structure of Models, Synchronous Reactive models, Dataflow models of computation, Timed models of computation | 06 |

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|---|---|---|
| 6. | **Security and Privacy in Cyber Physical Systems**<br>Security and Privacy Issues in CPSs, Cyber Security Laws in India: IT Act (2000), IPC (1980), Companies Act (2013), Local Network Security for CPSs, Security and Privacy for Cloud-Interconnected CPSs, Case Study: Cyber security in Digital Manufacturing/Industry 4.0 | **06** |

**References –**

**Text Books:**


- Principles of Cyber Physical Systems, Rajeev Alur, MIT Press.
- E. A. Lee, Sanjit Seshia , "Introduction to Embedded Systems – A Cyber–Physical Systems Approach", Second Edition, MIT Press, ISBN: 978-0-262-53381-2.


**Reference Books:**


- Guido Dartmann, Houbing song, Anke schmeink, "Big data analytics for Cyber Physical System", Elsevier.
- Houbing song, Danda B Rawat, Sabina Jeschke, Christian Brecher, "Cyber Physical Systems Foundations, Principles and Applications", Elsevier.
- Chong Li, Meikang Qiu, "Reinforcement Learning for Cyber Physical Systems with Cyber Securities Case Studies", CRC press.
- Houbing Song, Glenn A.Fink, Sabina Jesche, "Security and Privacy in Cyber-Physical Systems: Foundations, Principles and Solutions", IEEE Press.


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| Class: - **T. Y. B. Tech** | Semester-**V** |
|---|---|
| Course Code: **OE357** | Course Name: **Internet of Things** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
The Internet of Things (IoT) course explores the interconnected world of smart devices, enabling students to grasp the fundamentals of IoT architecture, protocols, and applications. Through hands-on projects, students develop skills in device integration and data management. The course equips learners with a comprehensive understanding of IoT's transformative potential, preparing them to navigate the evolving landscape of connected technologies and contribute to the advancement of the digital era.

**Course Learning Outcomes:**
After completion of this course, students will be able to:
1. Explain the concepts of network connected embedded devices.
2. Identify and summarize different components required for IOT applications.
3. Analyse the system through Data Analytics tools.
4. Design suitable network architecture and use appropriate protocols for a given IOT application.

**Prerequisite:** Basic knowledge of microprocessor and microcontroller, communication.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction & Basic of IoT**<br>Definition, Characteristics, Physical and Logical Designs, IOT enabling technologies, IoT levels and deployment templates. Major Components of IoT System. | 06 |
| 2. | **M2M and IOT management**<br>Introduction, M2M comparison with IOT, M2M architecture, software and development tools IOT management, communication technologies, communication protocols, Web connectivity tools. | 06 |
| 3. | **IoT platform design methodology**<br>Design methodology, IoT Device, IoT Platform Design Specification, Building blocks, Hardware and board approach, Useful Softwares and packages. | 06 |
| 4. | **IOT data storage and Cloud**<br>Data generation, local data storage and Purpose of Cloud, clouds used in IoT application, Cloud Storage Models, Communication APIs. | 06 |

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| **5.** | **IoT Security**<br>Vulnerabilities, security requirements, Threat analysis, IoT Security Tomography, Layered Attacker Model, Identity Management, Establishment, Access Control Secure Message Communication, Security Models. | **06** |
| **6.** | **Domain specific IOT**<br>Home automation, Cities, Environment, Agriculture, Health and lifestyle. | **06** |

**References-**

**Text Books:**


- Arshdeep Bahga, Vijay Madisetti., "Internet of Things - A hands On Approach", Universities Press.
- Raj Kamal," INTERNET OF THINGS - Architecture and Design Principles" McGraw Hill.


**Reference Books:**


- Simone Cirani, "Internet of Things- Architectures, Protocols and Standards", WILEY.
- Alessandro Bassi, "Enabling Things to Talk- Designing IoT solutions with the IoT Architectural Reference Model", Springer.


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| Class: - **T. Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **OE359** | Course Name: **Drone Technology** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course explores the revolutionary and riveting research in the ultramodern domain of drone technologies, drone-enabled applications. It explains the most recent developments in the field, challenges, and future scope of drone technologies. Beyond that, it discusses the importance of a wide range of design applications, drone/ Unmanned Aerial Vehicle (UAV) development.

**Course Learning Outcomes:**
After completion of this course, students will be able to:
1. Elaborate drone technology.
2. Explain fundamentals and design principles of UAV.
3. Discuss the wide range of applications of drone.
4. Classify various propulsion and controlling techniques for drone.

**Prerequisite:** Basic knowledge of electronics and control.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Definitions and Terminology, Types of Drone (based on wings), Physical Structure of Drone, Drone System Stack up of mechanical parts, Classification of UAVs, Military and Civilian Unmanned Aircraft. | 06 |
| 2. | **UAV Design Principles**<br>Introduction to UAV Design Principles, Computational and Experimental Design of a Fixed-Wing UAV, Payload Design of Small UAVs, Small UAV Design Development and Sizing, Systematic Design Methodology and Construction of Micro Aerial Quadrotor Vehicles. | 06 |
| 3. | **UAV Basic Components**<br>Four basic components: propeller, engine, body, and flight board, Fixed wing drone, main structural elements of drone Kinematics and Dynamics, Dynamics and Control of Flapping Wing MAVs, Principles of Guidance, Navigation, and Control of UAVs. | 06 |
| 4. | **UAV Propulsion**<br>UAV Propulsion: Introduction, Power Managements of a Hybrid Electric Propulsion System Powered by Solar Cells, Fuel Cells, and Batteries for UAVs. | 06 |

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|---|---|---|
| **5.** | **UAV Control**<br>Linear Flight Control Techniques for UAV, Nonlinear Flight Control Techniques for UAV, Adaptive Control of UAV: Theory and Flight Tests, Robust and Adaptive Control Methods for Aerial Vehicles. | **06** |
| **6.** | **UAV Applications**<br>Drone Usage areas: Agriculture, Environment, Survey of UAVs for Traffic Monitoring, Cooperative Unmanned Aerial Systems for Fire Detection, Barriers to drone Technology: Power Source & Security. | **06** |

**References-**

**Text Books:**

- Kimon P. Valavanis, George J. Vachtsevanos, Handbook of Unmanned Aerial Vehicles, Springer.

**Reference Books:**

- Neeraj Kumar Singh, Porselvan Muthukrishnan, Industrial System Engineering for Drones, Apress.
- Sachi Nandan Mohanty, J.V.R. Ravindra, Drone Technology: Future Trends and Practical Applications, Wiley.

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **OE351** | Course Name: **Hydrogen and Fuel Cell Technology** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
The course is a learning about hydrogen and fuel cells – the cornerstones of hydrogen and fuel cell energy. The focus is on understanding the main driving forces of global changes and earning the basic knowledge of the key technologies leading to alternative energy source.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Choose proper energy storage systems hydrogen and applications
2. Explain the different types of fuel cell technologies, fuels and membrane used in it
3. Design and Compare performance of fuel cell.

**Prerequisite:** Engineering Chemistry, Fluid Mechanics, Engineering Thermodynamics, Materials science

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Hydrogen energy**<br>Introduction to hydrogen economy, production, storage and transportation systems, hydrogen from fossil fuels, electrolysis of water, thermo chemical cycles, transmission and infrastructure requirements, safety and environmental impacts, economics of transition to hydrogen systems. | 06 |
| 2. | **Hydrogen production**<br>Methods, types of electrolyzer: proton-exchange membrane, alkaline, solid oxide, alkaline, microbial, efficiency, open circuit voltage, and losses. | 06 |
| 3. | **Hydrogen storage and transportation**<br>Methods of storage, solid, liquid, gaseous, Comparison between various methods, limitations, Transportation features, safety norms, methods, on borads and stationary applications. | 06 |
| 4. | **Fuel cells**<br>Concept, key components, physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, characteristics, Nernst equation, relation of the fuel consumption versus current output. | 06 |
| 5. | **Membranes &Fuels for Fuel Cells**<br>Membranes: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments. | 06 |

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|---|---|---|
| | Fuels: Hydrogen, methane, methanol – Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel. | |
| **6.** | **Fuel cell design and performance**<br>Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serial connection, over-potential and polarizations, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC. | **06** |

**References: -**

**Text Books:**


- J Larminie, A L Dicks, Fuel Cell Systems Explained, Wiley X Li, Principles of Fuel Cells, Taylor and Francis.
- Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry
- M. AuliceScibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India.


**Reference Books:**


- F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA.
- G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL.
- O'Hayre, R.P.S. Cha, W. Colella, F.B.Prinz, Fuel Cell Fundamentals, Wiley, N
- Basu,S.(Ed) Fuel Cell Science and Technology, Springer, N.Y.
- Dincer, H Ishaq, Renewable Hydrogen Production, Elsevier.
- G Naterer, I Dincer, C Zamfirescu, Hydrogen Production from Nuclear Energy, Springer.
- B Sorensen, G Spazzafumo, Hydrogen and Fuel Cells: Emerging Technologies and Applications, Academic Press.


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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y.B. Tech.** | Semester-**V** |
|---|---|
| Course Code: **CEMD301** | Course Name: **Infrastructure Engineering** |

| L | T | P | Credits |
|---|---|---|---|
| **3** | **-** | **-** | **3** |

**Course Description:**
This course provides an overview of infrastructure planning and design, covering roads, airports, railways, and harbors. Explore the history and present status of India's roads, delve into geometric design principles for highways, and learn about diverse pavement types. Gain insights into airport planning, runway layout, lighting, and markings. Conclude with a broad understanding of railway and harbor engineering for comprehensive insights into infrastructure development.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Apply the knowledge of geometric design in road construction.
2. Identify the quality parameters of pavement materials and various methods of road construction.
3. Discuss the various aspects of airport engineering.
4. Explain design parameters of railway engineering and it's component parts.
5. Summaries the different off shore structures for dock and harbors.

**Prerequisite:** Physics

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| **1.** | **Highway Planning**<br>Introduction: Classification of roads, Brief history of road development in India, Present status of roads in India, NHA1, NHDP, PMGSY, MSRDC; Geometric Design of Highways: Terrain classification, Design speed. Highway cross-section elements, Sight distance, Overtaking sight distance, Intersection sight distance. | 06 |
| **2.** | **Geometric Design of Roads**<br>Design of Horizontal Alignment: Horizontal curves, Design of super elevation and its provision, Radius at horizontal curves, Widening of pavements at horizontal curves, Methods of extra widening;<br>Design of vertical alignment: Different types of gradients, Grade compensation on curves, summit curves, valley curves. | 06 |
| **3.** | **Highway Construction**<br>Types of Pavement (Flexible and Rigid); Types of Roads: WBM, WMM, DBM, SDBC, SMA, PQC, DLC; Highway Drainage: Necessity, sub surface and surace drainage; PPP in Transport Sector. | 06 |

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|---|---|---|
| **4.** | **Airport Engineering**<br>Introduction: Advantage and limitation of air transportation, Aircraft component parts and characteristics, Importantterms in Airport planning, Airport layout: Imaginary surfaces, Zoning requirements Runway Location and orientation, Runway configuration, Characteristics of good layout, Basic runway length, Use of wind rose diagram. Airport Lighting and Markings. | 06 |
| **5.** | **Railway Engineering**<br>History of Indian Railways; Recent development in railways specifically w.r.t. track structure; Permanent Way; Component parts of railway track; Railway lines classification based on speed;<br>Geometric Design: Alignment, Gradient, Horizontal Curves, Superelevation; Points, Crossing and Turnouts; Signaling and Interlocking: Control of train movements and monitoring, Types of signals, Principal of interlocking; Modernization in Railway and Railway Tracks | 06 |
| **6.** | **Dock and Harbor Engineering**<br>Introduction, Planning and layout of ports, Classification, Site Selection, Breakwater, Jetties, Locks, Shore protection works. | 06 |

**References:**

**Text Books:**


- Khanna and Justo, "Highway Engineering", Nemchand Bros, Roorkee.
- L R Kadiyali, "Highway Engineering", Khanna Publisher.
- S.C. Saxena & S.P. Arora, "A textbook of Railway Engineering", Dhanpat Rai Publications.
- S. K. Khanna, M. G. Arora, "Airport Planning & Design", Nemchand Bros, Roorkee.


**Reference Books:**


- Partha Chakraborty and Animesh Das, "Principles of Transportation Engineering", Prentice Hall of India Ltd., New Delhi.
- Satish Chandra, M. M. Agarwal, "Railway Engineering" Oxford University Press India.


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| Class: - **T. Y.B. Tech.** | Semester-V |
|---|---|
| Course Code: **CSMD301** | Course Name: **Fundamentals of Database Systems** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
A database is an organized collection of data. A relational database, more restrictively, is a collection of schemas, tables, queries, views, and other elements. It defines data models, relational models, constraints that can be used in design of the relational database, also it focuses on file structure, transaction management and recovery of databases. The course also provides an overview of SQL which is used for implementation of relational databases. data. A general-purpose DBMS is a software system designed to allow the definition, creation, querying, update and administration of databases.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Describe the fundamental elements of relational database management systems.
2. Design ER-models to represent simple database application scenarios.
3. Write SQL query to perform various operations on the database.
4. Analyze principle of integrity constraints, Hashing and Indexing on databases.
5. Illustrate the transaction management, concurrency control and crash recovery.

**Prerequisites:**
A basic understanding of programming concepts (using languages such as Java, or C++) and foundational knowledge of data structures and algorithms.

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction to Database Concepts**<br>Purpose of Database Systems, Data abstraction, Data Models, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing E-R Diagrams to Tables, Generalization and Aggregation | **06** |
| **2.** | **Relational Model**<br>Structure of Relational Databases, Structured Query Language (SQL): Data Definition Language, Data Manipulation Language, Aggregate functions, Set Operations. | **06** |
| **3.** | **Integrity Constraints and Database Design**<br>Domain Constraints, Referential Integrity, Functional Dependencies, Decomposition, Normalization: 1NF, 2NF, 3NF | **06** |
| **4.** | **Data Storage and Indexes**<br>File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic. | **06** |
| **5.** | **Basic of Transactions**<br>Concepts of transaction processing, ACID properties, Transaction states, Serializability, Testing for serializability. | **06** |
| **6.** | **Concurrency Control and Recovery System**<br>Lock-based protocols, Timestamp - based Protocols.<br>Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints. | **06** |

**References –**

**Text Books:**


- Silberschatz, Henry F. Korth, and S. Sudharshan, "Database System Concepts", Tata McGraw Hill.
- J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Pearson Education.


**Reference Books:**


- Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson/Addision wesley.


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| Class:- **T.Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **EEMD301** | Course Name: **Electrical Machines** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | – | 3 |

**Course Description:**
The Electrical Machines minor course is designed to provide students with a fundamental understanding of the principles, operation, and applications of electrical machines in various engineering systems. This course serves as an introduction to the field of electrical machines, covering both theory and practical aspects. Students will gain insights into the performance, and control of electrical machines, which are essential components in modern electrical and electronic systems.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Describe behavior of dc machine.
2. Explain the working principle of 1-Phase and 3-Phase transformers.
3. Explain working of different induction motors.
4. Select the relevant electrical machines for different applications.
5. Interpret the relevant fractional horse power motor for different applications.

**Prerequisite:** Basic Electrical Engineering, Engineering mathematics and Engineering physics.

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| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **DC Machine**<br>Fleming's right hand rule, Construction of dc machine with their parts information, Principle of operation of dc generator and Motor, Fleming's left hand rule, Voltage equations of dc motor, Torque equation of dc motor, Characteristics of dc motors, Speed control methods of dc motor, Applications of dc machine. | **06** |
| **2.** | **Transformer**<br>Construction of 1-Phase and 3-Phase transformer, Principle of operation, EMF equation of transformer, transformation ratio, Types of transformers, Ideal transformer on no load, Practical transformer on no load and on load, Phasor diagram of practical transformer for different loads, Losses in transformer, efficiency of transformer, Applications of transformer. | **06** |
| **3.** | **Induction Motors**<br>**1-Phase Induction motor:**<br>Resistance start/Split phase induction motor, Capacitor start induction run motor, Capacitor start capacitor run induction motor<br>**3-Phase Induction motor:** Construction and working of 3-Phase Induction motor, Types of 3-Phase Induction motors, Synchronous speed, rotor speed, Slip, Torque equation of 3-Phase Induction motor, Torque-Slip characteristic of 3-Phase Induction motor, Need and types of starters, Speed Control of 3-Phase Induction motors Applications of induction motors. | **06** |
| **4.** | **Synchronous machines**<br>**Alternator:** Construction and working principle, EMF equation, Types of rotors, Terminal voltage, Armature reaction at various p.f., Voltage regulation<br>**Synchronous Motor:** Construction and working principle, Different torques in synchronous motor, Effect of excitation, Applications of synchronous machines. | **06** |
| **5.** | **Fractional Horse Power Motors**<br>Permanent Magnet DC Motor (PMDC), Brushless DC Motor (BLDC), Steeper Motors, AC and DC Servo Motor, SRM, Universal motor. Applications of various special purpose motors. | **06** |
| **6.** | **Electric Drives**<br>Introduction to controlled rectifiers, Electric Drives, Advantages of Electrical drives, Parts of electrical drives, Choice of electrical drives, Status of ac and dc drives, fundamental torque equations, Multiquadrant operation, Classification of drives | **06** |

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**References –**

**Text Books:**


- Ashfaq Husain, Electric Machines, Dhanpat Rai & Co.
- V K Mehta, Principle of Electric Machine, S Chand Publication.
- D.P. Kothari, I Nagrath, Electric Machines, Tata McGraw-Hill Education.


**Reference Books:**


- P. S. Bimbhra , Electrical Machinery, Khanna Publishers.
- B.L.Theraja and A.K.Theraja, Electrical Technology, S Chand Publication.
- Charles I. Hubert, Electric Machines: Theory, Operating Applications, and Controls, Pearson publication.


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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T. Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **ECMD301** | Course Name: **Advanced Communication Systems** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course covers the basics of antenna and wave propagation, key antenna parameters, and various antenna types. It includes an overview of 5G communication systems, channel modeling, and the challenges of 5G wireless propagation. Additionally, the course introduces modern communication techniques like fiber optics, GSM, CDMA, LTE, Bluetooth, WiFi, ZigBee, LoRA, and RFID.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Explain the principles of antenna and wave propagation.
2. Understand basic antenna parameters and their types.
3. Discuss the evolution, requirements, and challenges of 5G communication systems.
4. Understand and compare various communication techniques.
5. Communicate effectively on complex engineering topics related to modern communication techniques.

**Prerequisite:** Knowledge of basic analog and digital communication.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Basics of Antenna and Wave Propagation**<br>Introduction to Antenna and wave propagation, Types of wave propagation, Wave Polarization, Types of Wave polarization. | 06 |
| 2. | **Antenna Parameters**<br>Basic Antenna parameters: Antenna pattern, Half power beam width, Beam area, Radiation intensity, Beam efficiency, Directivity and Gain, Resolution, Front to Back ratio, Effective height, Reflection coefficient, Impedance bandwidth, and pattern bandwidth. | 06 |
| 3. | **Types of Antennas**<br>Dipole Antenna, Antenna Array, Wire Antenna, Microstrip Antenna, Aperture antenna, Dish Antenna, Yagi Uda Antenna. | 06 |
| 4. | **Overview of 5G Communication**<br>Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G,Spectrum Analysis and Sharing for 5G. | 06 |

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|---|---|---|
| **5.** | **The 5G wireless Propagation Channels**<br>Channel modeling requirements, propagation scenarios, and challenges in the 5G modeling, Channel Models for mm-Wave MIMO Systems. | **06** |
| **6.** | **Communication Techniques**<br>Fundamentals of Fiber Optics Communication, GSM, CDMA, LTE, Blue Tooth, WiFi, ZigBee, LoRA, RFID. | **06** |

**References -**

**Text Books:**


- Constantine A. Balanis "Antenna Theory: Analysis and Design" Wiley Publication.
- John D. Kraus and Ronald J. Marhefka "Antennas and Wave Propagation" McGraw-Hill Publication.
- Theodore S. Rappaport "Wireless Communications: Principles and Practice" Pearson Publication.
- Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.


**Reference Books:**


- John D Kraus, Antenna for all Application, TMH publication
- Louis Frenzel, "Communication Electronics Principles and Applications" TMH Publication.
- Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.


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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T. Y. B. Tech.** | Semester-V | | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|---|---|
| Course Code: **CIMD301** | Course Name: **Introduction to DBMS** | | **3** | **-** | **-** | **3** |

**Course Description:**
A database is an organized collection of data. A relational database, more restrictively, is a collection of schemas, tables, queries, views, and other elements. It defines data models relational models, constraints that can be used in design of the relational database, also it focuses on file structure, transaction management and recovery of databases. The course also provides an overview of SQL which is used for implementation of relational databases. data. A general-purpose DBMS is a software system designed to allow the definition, creation, querying, update and administration of databases.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Describe the fundamental elements of relational database management systems.
2. Design ER-model store present simple database application scenarios.
3. Write SQL query to perform various operations on the database.
4. Analyze principle of integrity constraints, Hashing and Indexing on databases.
5. Illustrate the transaction management, concurrency control and crash recovery.

**Prerequisite:** Data Structures

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Database Concepts**<br>Purpose of Database Systems, Data abstraction, Data Models, Entities and Entity sets, Mapping Constraints, E-R Diagram, Reducing E-R Diagrams to Tables, Generalization and Aggregation. | **06** |
| 2. | **Relational Model**<br>Structure of Relational Databases, the Relational Algebra, the Tuple Relational Calculus, Structured Query Language (SQL), Joins. | **06** |
| 3. | **Integrity Constraints and Database Design**<br>Domain Constraints, Referential Integrity, Complex datatypes, Functional Dependencies, Pitfalls in Relational Database Design, Decomposition, Normalization. | 06 |
| 4. | **Data Storage and Indexes**<br>File Organization, Data Dictionary Storage, Indexing: B+ tree indexing and B tree indexing, Hashing: Static and Dynamic. | 06 |

| | | |
|---|---|---|
| **5.** | **Query Processing and Basic of Transactions**<br>Overview, Query Interpretation, Concepts of transaction processing, ACID properties, Transaction states, Serializability, Testing for serializability. | 06 |
| **6.** | **Concurrency Control and Recovery System**<br>Lock-based protocols, Timestamp - based Protocols, Multiple Granularities, Deadlock handling, Crash Recovery: Failure Classification, Log-Based Recovery, Checkpoints, Shadow Paging | 06 |

**References-**

**Text Books-:**


- Abraham Silberschatz, Hank Korthand S. Sudarshan, "Database System Concepts", McGraw Hill Education.
- Ram Krishnan, Johanses Gehrke, "Database Management Systems", McGraw Hill Education.


**Reference Books-:**


- J. D. Ullman, "Principles of Database Systems", Galgotia Publications.
- Jio Wiederhold, "Database Design", McGraw Hill International.
- Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage".


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**T. Y. B. Tech. Syllabus**

To be implemented for 2024-28 NEP Batch

**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y.B. Tech.** | Semester-V |
|---|---|
| Course Code: **MEMD305** | Course Name: **Product Design Tools and Techniques** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**

This course introduces students to the fundamental and advanced tools and techniques used in product design, focusing on engineering principles, design for manufacturability, value engineering, concurrent engineering, reverse engineering, and prototyping. The course will combine theoretical foundations with practical applications, including case studies.

**Course Learning Outcomes:**

After successful completion of the course, students will be able to,

1. Explain the basic principles of engineering design.
2. Design products for ease of manufacturing and assembly.
3. Apply value engineering and concurrent engineering principles in product design.
4. Apply reverse engineering on a product.
5. Apply various prototyping techniques, including rapid prototyping technologies.

**Course Content**

| Unit No | Description | Hrs. |
|---|---|---|
| 1. | **Principles of Engineering Design** Introduction to engineering design, Introductory principles – Iteration, Compromise, Complexity, Responsibility, Simplification., Problem identification, Creativity, Concept selection, Embodiment, Modelling, Detail design, Design management, Information gathering. | 06 |
| 2. | **Design for Manufacturability, Assembly and Sustainability** Overview of DFM and DFA principles, Case studies of DFM and DFA, Techniques and Tools for DFM and DFA, Techniques to simplify manufacturing processes, Tools for assessing and optimizing assembly processes, Environmental Considerations in Manufacturability and Assembly, Introduction to sustainable design and environmental impact, Tools for environmental assessment, including life-cycle analysis. | 06 |
| 3. | **Value Engineering** Introduction, Nature and Measurement of Value, The Value Analysis Job Plan, Steps to Problem-Solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Check-list, Cost Reduction Through Value Engineering, Case Study on Tap Switch Control Assembly, The Methodology, Benefits of Value Engineering, Material and Process Selection in Value Engineering. | 06 |

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| **4.** | **Concurrent Engineering**<br>Introduction to Concurrent Engineering, Fundamentals of CE, Need and basic principles of CE, Benefits of implementation of CE, Introduction to various integrating mechanisms, forming of CE team. Teamwork: Interfacing of manufacturing and design, selection of key techniques and methodologies, selection of CE tools. | **06** |
| **5.** | **Reverse Engineering**<br>Scope and tasks of RE, Process of duplicating, Definition and use of Reverse Engineering, Reverse Engineering as a Generic Process, Cognitive approach to RE, Integration of formal and structured methods in reverse engineering. | **06** |
| **6.** | **Modern Prototyping Techniques**<br>Traditional prototyping methods, additive manufacturing (3D printing), subtractive manufacturing (CNC machining), Rapid prototyping applications. AM process chain, Classification of AM processes, Design for AM, Post Processing. | **06** |

**References-**

**Text books:**


- Engineering Design Principles, Kenneth S. Hurst,Butterworth-Heinemann.
- Katheryn, A. Ingle, Reverse Engineering, McGraw-Hill.
- Product Design for Manufacture and Assembly, G. Boothroyd, CRC Press Inc.
- Product Design and Manufacturing, A.K. Chitale and R.C. Gupta, PHI Learning Private Limited, Delhi.
- Chua Chee Kai, Leong Kah Fai, Rapid Prototyping: Principles & Applications, World Scientific.


**Reference Books:**


- Linda Wills, Reverse Engineering, Kluiver Academic Publishers.
- Larry W. Zimmerman, Glen D. HartVan Nostrand Reinhold, Value Engineering: A Practical Approach for Owners, Designers, and Contractors, SAVE International.


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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T.Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **MCMD301** | Course Name: **Sensor and Instrumentation** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | – | 3 |

**Course Description:**
This course provides an in-depth understanding of sensors and instrumentation used in mechatronics systems. Students will learn the principles of various sensors and their applications in measuring physical quantities. The course will cover topics such as sensor types, signal conditioning, data acquisition, and integration of sensors into mechatronics systems with real life applications.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Understand the fundamental principles of various sensors and transducers.
2. Analyze the characteristics, advantages, and limitations of different sensor types.
3. Apply appropriate signal conditioning techniques to improve sensor output accuracy and integrate sensors into mechatronic systems for real-time data acquisition and control.
4. Select appropriate sensors for specific mechatronic systems used in real life applications.

**Prerequisites:** Basic knowledge of mechatronics systems, Familiarity with electronics and electrical circuits.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Mechatronics and Sensors**<br>Definition and scope of mechatronics, Role of sensors in mechatronic systems, Classification of sensors based on transduction principles, Sensor Characteristics and Performance Parameters such as sensitivity, accuracy, precision, resolution, hysteresis, etc., Calibration and compensation techniques. | 06 |
| 2. | **Temperature Sensors**<br>Thermocouples, Resistance Temperature Detectors (RTDs), Thermistors, Infrared (IR) temperature sensors.<br>**Position and Displacement Sensors:**<br>Potentiometers, LVDT (Linear Variable Differential Transformer), Optical encoders, Inductive sensors. | 06 |
| 3. | **Force and Pressure Sensors** | 06 |

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| | | |
|---|---|---|
| | Strain gauges, Load cells, Pressure transducers, Piezoelectric, Piezoresistive, and Capacitive Pressure Sensors, Ultrasonic Sensors<br>**Motion and Velocity Sensors:**<br>Accelerometers, Gyroscopes, Proximity sensors, Hall Effect Sensors. | |
| **4.** | **Light and Imaging Sensors**<br>Photodiodes, Phototransistors, Image sensors (CMOS, CCD)<br>**Wireless and IoT Sensors:**<br>Bluetooth, Wi-Fi, Zigbee, and other wireless protocols, Integration of sensors into IoT platforms. | 06 |
| **5.** | **Sensor Interfacing and Signal Conditioning**<br>Amplification and filtering, Analog-to-Digital Conversion (ADC), Sensor interfaces, Noise reduction and error compensation<br>**Data Acquisition and Processing:**<br>Sampling theorem and Nyquist frequency, Data acquisition systems (DAQ) Analog and digital signal processing, Sensor fusion techniques | 06 |
| **6.** | **Case Studies and Real-World Applications**<br>Robotics and automation systems, Autonomous vehicles, Biomedical applications, Health care, defense applications, agricultural applications, automobile sector, communication devices, home security. | 06 |

**References -**

**Text Books:**


- Principle of Industrial Instrumentation by D. Patranabis, Tata McGraw Hill.
- Instrumentation and Measurement Principles by . D.V.S. Murty, PHI, New Delhi,
- Electrical and Electronics Measurement and Instrumentation by A.K. Sawhney,
- Dhanpat Rai & Co,
- Process control instrumentation technology by Curtis D. Johnson, PHI learning Pvt.Ltd.


**Reference Books:**


- Measurement Systems by E.O. Doebelin, McGraw Hill,
- Process Measurement & Analysis by B.G. Liptak, CRC press,
- Instrumentation Devices and Systems by C. S. Rangan, G. R. Sharma and V. S. Mani,
- Tata McGraw-Hill Publishing Company Ltd., New Delhi,
- Mechanical and Industrial Measurements by R. K. Jain, Khanna Publishers,


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**T. Y. B. Tech. Syllabus**
To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T. Y. B. Tech.** | Semester-V | | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|---|---|
| Course Code: **AIMD301** | Course Name: **Machine Learning** | | **3** | **-** | **-** | **3** |

**Course Description:**
The students will understand the basics of Machine Learning. They will learn to apply different machine-learning algorithms to various datasets.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Utilize machine learning techniques and understand the basic theory underlying machine learning.
2. Articulate supervised, unsupervised and reinforcement learning
3. Identify the basic concepts of learning and decision trees.
4. Utilize Bayesian techniques for problems appear in machine learning.
5. Perform statistical analysis of machine learning techniques.

**Prerequisites:** Basic knowledge of Probability theory and python programming

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction**<br>Learning in the context of ML, three phases of performing ML, Algorithms and Models in ML, Logical, Geometric and Probabilistic models, Underfitting, Overfitting and Right models, Practical ML examples, Types of ML problems, Classification of ML algorithms. | 06 |
| **2.** | **Decision Trees**<br>Purpose and uses, Constructing a decision tree, Gini Index, Gain ratio, ID3, C4.5, CART, Benefits of decision tree, Random Forest.. | 06 |
| **3.** | **Regression-Based Learning**<br>Regression Analysis, Covariance, Correlation Coefficient, Regression Methods, Simple liner regression, Regression Model, Multiple Regression, Polynomial regression, Generalized linear models, Logistic regression. | 08 |
| **4.** | **Instance Based Learning and kernel-methods based learning**<br>KNN algorithm, Determining K, distance measures in KNN, Case based Reasoning, Support vector Machines (SVM). | 06 |
| **5.** | **Clustering Based Learning**<br>Types of clustering, K-means clustering algorithm, Advantages and dis-advantages of K-means clustering, Distance measures. | 06 |

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|---|---|---|
| 6. | **Bayesian learning**<br>Classical, Empirical, Subjective methods, Types of events, Types of probabilities, Normal Distribution, Bayes' Theorem, Naïve Bayes' classifier | 06 |

**References-**

**Text Books:**

- Sunila Gollapudi "Practical Machine Learning" PACKT Publishing.
- Mitchell, Tom. M., "Machine Learning", McGraw-Hill Education.
- John Paul Mueller and Luca Mueller, "Machine Learning for Dummies".

**Reference Books:**

- Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Tylor and Francis Publication.

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **RAMD301** | Course Name: **Kinematic & Dynamics for Robots** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course provides an opportunity for the students of other engineering programs to learn kinematic and dynamic analysis of the robots. The fundamental concepts of mechanisms and methods of mechanism design and selection are introduced. The course covers the concepts of kinematic and dynamic analysis of robots such as forward kinematics, inverse kinematics and robot dynamics. The robot gripers, manipulators, their dynamic analysis and workspace analysis is also covered in the course. The course outcomes will ultimately help to perform synthesis of mechanisms and kinematic and dynamic analysis of different robots for various applications.

**Course Outcomes:**
After completion of this course student will be able to -
1. Select the type of mechanism for the robotic applications
2. Perform kinematic analysis and synthesis of mechanisms.
3. Perform forward and inverse kinematics of robots
4. Perform workspace analysis for different types of robots
5. Design robot manipulators based on dynamic analysis
6. Perform forward and inverse dynamics of robots

**Prerequisite:** Kinematics of Machines, Dynamics of Machines

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Fundamental Concepts**<br>Kinematic Links, kinematics pair, types of constrained motion, Kinematic chain, Degrees of freedom, mechanisms, inversion of mechanism, position and orientation of rigid body, Linear and angular velocity of links, Velocity propagation, synthesis of mechanisms | 06 |
| 2. | **Forward Kinematics**<br>Robot kinematics, D-H representations and displacement matrices for standard robot configurations, The ARM equation, Forward kinematics of manipulators up to 6 degrees of freedom, representation of forward kinematic equations. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots. | 06 |
| 3. | **Inverse Kinematics**<br>Inverse kinematic analysis of robot with standard configurations, methods for solution of non-linear simultaneous equations, singularity analysis, | 06 |

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|---|---|---|
| | Inverse kinematic solution of Robots - Inverse kinematics off our axis SCARA robot and three and five axis Articulated robot. | |
| 4. | **Workspace Analysis**<br>Workspace analysis, work envelope of a Four axis SCARA robot and five axis articulated robot, workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique in trajectory planning, | 06 |
| 5. | **Robot End Effectors**<br>Classification of the Robot End effectors- tools and grippers, selection and Design consideration of the gripper, mechanical grippers, vacuum grippers, magnetic grippers, adhesive grippers, RCC grippers, gripper force analysis, Materials for hostile operation of gripper.<br>Tools used as end effectors- welding gun, spray gun, drilling tool etc., Tool center point (TCP) | 06 |
| 6. | **Manipulator Dynamics**<br>Kinetics of rigid bodies – Work energy principle, Linear and angular momentum, conservation laws, Forward Dynamics and Inverse Dynamics, Spatial description and transformations, Dynamic parameters identification, Newton-Euler formation, Lagrange-Euler formation, Dynamic model of simple manipulator structures, Dynamic model of a Two-axis planar robot | 06 |

**References:**

**Text Book-**


- Groover M.P., Weiss M., Nagel R.N., Odrey N.G., "Industrial Robotics Technology-Programming and Applications", McGraw Hill Book Co
- S. K. Saha, Introduction to Robotics, TATA McGraw Hills Education, 2014.
- S. S. Ratan, Theory of Machines, Tata McGraw Hill


**Reference Books-**


- Robert J. Schilling, Fundamentals of Robotics Analysis and Control, PHI Learning.
- Richard D. Klafter, Thomas. A, Chri Elewski, Michael Negin, Robotics Engineering: An Integrated Approach, PHI Learning.
- Francis N-Nagy Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
- Bernard Hodges, Industrial Robotics, Second Edition, Jaico Publishing house.
- Tsuneo Yohikwa, Foundations of Robotics Analysis and Control, MIT Press.
- John J. Craig, Introduction to Robotics Mechanics and Control, Pearson.
- Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
- J. E. Shigley and J.J.Uicker Jr., Theory of Machines and Mechanism, McGraw Hill
- Kelly R, Santibanez V and Loria A, - Control of Robot Manipulators in Joint Space, Springer.
- John J. Craig, Introduction to Robotics, Addison Wesley.


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**T. Y. B. Tech. Syllabus**
To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T. Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **CEMD303** | Course Name: **Smart Cities & Sustainable Development** |

| L | T | P | Credits |
|---|---|---|---|
| **2** | **-** | **-** | **2** |

**Course Description:**
This course will introduce students to the concepts of smart cities and different ideologies of smart cities and sustainable development. Different approaches of different countries all over the world toward smart cities and sustainable development will be studied and evaluated. The current smart city mission in India its plans and provisions and different aspects will also be studied and critically evaluated. Measurement of sustainability and its assessing framework will also be studied under this course. Present condition of sustainability in India its needs, issues and challenges will also be studied.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Develop a critical understanding of the different concept and ideologies of smart cities.
2. Analyse the different approaches toward planning and development of smart cities on global level.
3. Assess the existing state and approach of Smart city Mission in India.
4. Comprehend the concept of resilience and sustainable development and its measurement.
5. Evaluate the present status of sustainability and rating systems initiatives within the Indian context.

**Prerequisite:** Basics of civil engineering

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Smart cities concept, origin, ideology. Typologies and different meanings, Wired city, Virtual city, Intelligent city, Information city, Digital city. Characteristics of smart cities: smart economy, smart people, smart governance, smart mobility, smart environment, smart living Strategies and policies. | 04 |
| 2. | **Critical analysis of Smart City Concept**<br>Approaches towards smart cities in various countries. Smart city planning in advanced economies, economic, financial viability, social implications. Financial and economic viability of smart city. Critical analysis of smart city development projects in India | 04 |

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|---|---|---|
| 3. | **Smart City Mission in India**<br>Smart city mission: Objectives, features, coverage and duration. Preconditions and criteria for the selection of smart city, actions and tools for smart cities Strategies, redevelopment, Greenfield, Brownfield, pan-city, Governance and management special purpose vehicles. | 04 |
| 4. | **Resilience and Sustainable Development**<br>Sustainable Development Introduction, Origin, Definition, three pillars of Sustainable Development, Critiques on Sustainable Development. The concept of resilience: need and significance in the contemporary time, city preparedness, adaptations, risk reduction and mitigation. Climate change and resilience. | 04 |
| 5. | **Measurement of Resilience and Sustainability**<br>The Theory and Measurement of Sustainability: Ideologies and Ethos of Sustainability, Indicators, Indicator Framework for Assessing Sustainability, Measurement Systems for Sustainable Urban Development: Concept Level (Broad) Measurement Systems. | 04 |
| 6. | **Sustainability in India**<br>Sustainability in India: Need, Issues and Challenges, Urbanization in India, Sustainable Development in India, Sustainability Measurement and Rating Systems and Initiatives in India. | 04 |

**References-**

**Text Books:**


- Sharma P. and Rajput S., "Sustainable Smart Cities in India", Springer International Publishing.
- Srinivasan R., Sookoor T., Jeschke S., "Smart Cities: Foundations, Principles, and Applications", John Wiley Publishing.


**Reference Books:**


- Mora L., Deakin M., "Untangling Smart Cities", Elsevier Science.
- Dag R. Bennett, Diana Pérez-Bustamante Yábar, "Sustainable Smart Cities", Springer International Publishing.
- Ministry of Environment and Forests, "Sustainable Development in India: Stocktaking in the run up to Rio+20", Government of India.

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **CSMD303** | Course Name: **Object-oriented Programming in Python** |

| L | T | P | Credits |
|---|---|---|---|
| 1 | -- | 2 | 2 |

**Course Description:**
This course is designed to introduce students to the Python programming language, providing a solid foundation in its syntax, principles, and applications. Through hands-on coding exercises and projects, students will gain practical experience, enabling them to apply Python to various programming tasks and problem-solving scenarios. The course emphasizes good coding practices, algorithmic thinking, and an understanding of key programming concepts.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Demonstrate a comprehensive understanding of Python syntax, data types, and basic operations.
2. Make use of common Python libraries for data manipulation.
3. Implement lists, tuples, sets, and dictionaries for effective data handling.
4. Apply principles of OOP, including classes, objects, inheritance, and polymorphism.

**Prerequisite:** Basic understanding of programming concepts.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Python fundamentals**<br>Python introduction, Python syntax, Python comments, Python variables, Python data types, Python numbers, Python casting, Python strings, Python Booleans, Python operators, Loops and Conditional Statement If-else, while, for, lambda, arrays, Python Iterators, Python scope. | 02 |
| 2. | **Lists, Tuples, Sets, Dictionaries**<br>Access, change, add and remove list elements, loop lists, list comprehension, list methods, access, update, unpack tuples, loop tuples, tuple methods, Access, add, remove set items, set methods, access, add, change, remove dictionary items, nested dictionaries, dictionary methods. | 02 |
| 3. | **Classes and Objects**<br>Classes, objects, parameterized and non-parameterized init constructor, object methods, self-parameter, association, Access modifiers: Private, public, protected. | 02 |

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|---|---|---|
| 4. | **OOP Concepts**<br>Inheritance, Encapsulation, Polymorphism: overloading and overriding, abstraction: interface and abstract class | 02 |
| 5. | **File handling and Exception**<br>File handling syntax, read files, write/create files, delete files, handing runtime exception and custom exception. | 02 |
| 6. | **Modules and Libraries**<br>Introduction, modules, using dir() function, Numpy, Pandas, Matplotlib, Seaborn, markers, line, labels, grid, subplots, scatter, bars, histograms, pie-charts. | 02 |

**It should consist of minimum 10 experiments based on the syllabus and experiment list mentioned below.**

| Course Content | | |
|---|---|---|
| **Exp No** | **Description** | **Hrs** |
| 1. | Write Python programs using variables, data types, operators, input/output statements, type casting, and comments. | 02 |
| 2. | Implement programs using if-else, nested if, while loop, for loop, break, continue, and pass statements. | 02 |
| 3. | Perform string operations, slicing, string methods, user-defined functions, lambda functions, and scope of variables. | 02 |
| 4. | Create and manipulate lists, tuples, sets, and dictionaries using various built-in methods and comprehensions. | |
| 5. | Implement iterators, iterable objects, and perform operations on arrays. | 02 |
| 6. | Create classes and objects using constructors, object methods, and self parameter. | 02 |
| 7. | Demonstrate public, private, and protected members along with association between classes. | 02 |
| 8. | Implement single, multilevel inheritance, method overriding, and method overloading concepts. | 02 |
| 9. | Develop programs using abstract classes, interfaces, encapsulation, and data hiding techniques. | 02 |
| 10. | Perform file read/write/create/delete operations and implement runtime and custom exception handling. | 02 |
| 11. | Create user-defined modules, use dir() function, and perform array operations using NumPy. | 02 |

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|---|---|---|
| **12.** | Perform data manipulation using Pandas and create plots such as line chart, bar chart, histogram, scatter plot, pie chart, and subplots using Matplotlib/Seaborn. | 02 |

**References -**

**Text Books:**

- "Python Programming: A Modular approach" by Sheetal Taneja, Naveen Kumar.
- "Python Programming: Using Problem Solving Approach" by Reema Thareja.

**Reference Books:**

- "Learning Python: by Mark Lutz
- "The Complete Reference: Python" by Martin C. Brown.

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **EEMD305** | Course Name: **Electrical Technology** |

| L | T | P | Credits |
|---|---|---|---|
| 1 | - | 2 | 2 |

**Course Description:**
This laboratory course emphasis on imparting the practical knowledge and understanding of basic principles, characteristic, performance and testing of electrical systems. In this lab course, students will be familiar with the use of different electrical equipment and safety precautions on work place.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Demonstrate speed control methods of electrical machines.
2. Analyze performance of DC motor and induction motor for speed control applications.
3. Implement power electronic circuits for given application.
4. Measure electrical quantities using electrical and electronic instruments.

**Prerequisite:** Basic Electrical Engineering, Basic Electronics Engineering

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Power Electronic Devices**<br>Power diode, BJT, Thyristor, MOSFET, IGBT: Structure, Symbol, Working Principle, Comparison. | 02 |
| 2. | **Power Electronic Circuits**<br>Rectifier: single phase full wave diode rectifier, Chopper: basic step-down and step-up Chopper, Inverter: single phase full bridge inverter. | 02 |
| 3. | **Electrical and Electronic Measurements**<br>Electrical instruments, characteristics of measuring instruments, standards of measurement, voltmeter, ammeter and wattmeter, digital multi-meter, power analyzer. Comparison of analog and digital meters. | 02 |
| 4. | **Transducers**<br>Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Measurement of weight, speed, temperature, pressure and flow. | 02 |
| 5. | **Solar and Wind Energy Systems**<br>Solar cell fundamentals, V-I characteristics of a PV panel, principles of wind energy conversion, components of wind energy conversion system, | 02 |

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|---|---|---|
| | classification of wind turbines- horizontal axis and vertical axis. Wind power integration into grid-power system, grid connected PV systems. | |
| 6. | **Electric Vehicle**<br>What Is an Electric Vehicle? Engineering philosophy of EV development, Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric Vehicle, Fuel-Cell Electric Vehicle, Overview of EV Technologies. | 02 |

| Expt. No. | Description | Hrs |
|---|---|---|
| 1 | Study of different starters of DC Motors. | 02 |
| 2 | Perform speed control of DC Shunt Motor by Armature Voltage and Field Current Control Method. | 02 |
| 3 | Perform polarity test on single-phase Transformer. | 02 |
| 4 | Perform speed control of an Induction Motor. | 02 |
| 5 | Measurement of active & reactive power for three phase supply. | 02 |
| 6 | Measurement of Electrical parameters by Power Analyzer. | 02 |
| 7 | Study of Single-Phase Full Wave Rectifier | 02 |
| 8 | Study the effect of wind speed on wind power generation. | 02 |
| 9 | Plot I-V and P-V characteristics of PV modules. | 02 |
| 10 | Study of Electric Vehicle and Battery Management System. | 02 |

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T. Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **ECMD303** | Course Name: **Electronic Product Design** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | - | - | 2 |

**Course Description:**
This course aims to introduce various methods, processes and protocols in product design. In this course student will develop a strong fundamental base for the design of electronic product.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Elaborate product design processes.
2. Explain various aspects of PCB design.
3. Differentiate product-testing methods.
4. Create various documents for the product.

**Prerequisite:** Knowledge of basics analog and digital electronics and communication.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Product Design and Development**<br>Introduction, Product Development Basics, Product Development Stages, Identification of the Customer Requirements, Techno-Commercial Feasibility of a Product, Pilot Production Batch, Product Assessment, Availability, Screening Test of Component, Redundancy, Ergonomic and Aesthetic Design Considerations. | 04 |
| 2. | **Noise and Heat Management**<br>Power Supply Protection Devices, Transient Voltage Suppressor, Fuses, Line Filters, Noise Consideration of a Typical System, Noise in Electronic Circuits, Grounding, Shielding, Guarding. Thermal Management. | 04 |
| 3. | **PCB Design**<br>Introduction to PCBs, Layout, Issues Related to PCB Size, Design Issues Related to Supply and Ground Conductors, Multilayer Boards, Component Assembly Techniques, Comparison of PCBs. | 04 |
| 4. | **Hardware and software Design and Testing Methods**<br>Introduction, Signal Integrity, Software Design and Testing Methods, Phases of Software Design, Selection of Language for Software Development, Assemblers, Compilers, Simulators, Emulators. | 04 |
| 5. | **Electronic Product Testing**<br>Introduction, Environmental Testing, Temperature Testing, Thermal Modeling of Components, Humidity Testing, Electrical Overstress Testing, | 04 |

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| | Altitude Testing, Special Testing, Environmental Test Chambers and Rooms, Various Tests on Enclosures, EMI and EMC Related Testing, Importance of Standards, List of Some Standards. | |
| 6. | **Product Documentation**<br>Introduction, Types of Documentation, How to Prepare an Effective Document, PCB Documentation, Bill of Material: A Documentation of Part List, Manual Types. | 04 |

**References -**

**Text Books:**


- R.G.Kaduskar, V.B.Baru, Electronic Product Design, Wiley Publication.


**Reference Books:**


- Walter C Bosshart, Printed Circuit Board design and technology, Tata McGraw Hill.
- Clyde Coombs, Handbook of Printed Circuit, MCGraw Hill publication.
- M.G. Loveday, Electronic testing and fault diagnosis, Longman publication.

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **CIMD303** | Course Name: **OOP using Java** |

| L | T | P | Credits |
|---|---|---|---|
| 1 | -- | 2 | 2 |

**Course Description:**
Object Oriented Programming is pillar of software development. The strong knowledge of object-oriented programming helps to create the better software. The main aim of this course is to cover the object-oriented concepts with java programming language. This course lets students to write computer programs using Java Development Kit and using the principles of Object-Oriented paradigm. The course covers Object-Oriented concepts, Java classes, array, exception handling, string API in Java. Students will develop desktop applications by using object-oriented concepts with use of Java Standard Edition. This course is also useful for learning the advanced java courses such as JSP, Servlet, Struts, and spring frameworks.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Explain the concepts and terminologies in object-oriented concepts and java programming language.
2. Apply object-oriented programming features and concepts for solving given problem.
3. Develop the java application using the collection framework to solve real word problem.
4. Apply the concepts exception handling to develop error free codes.
5. Utilize the concepts of package to develop efficient codes.

**Prerequisite:** Basic knowledge of C Programming

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Java Programming**<br>Java buzzwords, Features of Java, JDK, JRE and JVM, Variables and data types, I/O statements in Java, Conditional and looping statements, Arrays. | 02 |
| 2. | **Introduction to Object-Oriented Programming**<br>Features of object-oriented programming, Class and objects, Constructors, Method and constructor overloading, Nested classes. | 02 |
| 3. | **Features of Object-Oriented Programming**<br>Polymorphism: Method overloading (Compile time Polymorphism), Method overriding (Run time Polymorphism), Inheritance, super, this, static and final keywords, Abstraction, Interface, Garbage collection. | 02 |
| 4. | **Collection and String** | 02 |

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| | | |
|---|---|---|
| | Collection, Collection Framework, List: ArrayList, LinkedList, Vector and Stack, Queue: Deque and Priority Queue, Set: TreeSet and HashSet, Map: Hash Table and Hash Map, Java String. | |
| 5. | **Exception Handling**<br>Exceptions & Errors, Types of Exception, Control Flow in Exceptions, JVM reaction to Exceptions, Exception keyword. In-built and User Defined Exceptions, Checked and Un-Checked Exceptions. | 02 |
| 6. | **Packages**<br>Organizing Classes and Interfaces in Packages, Package as Access Protection Defining Package, CLASSPATH Setting for Packages, Naming Convention for Packages. | 02 |

| **Course Content** | | |
|---|---|---|
| **Experiment No.** | **Description** | **Hrs** |
| **1** | Introduction to Java Programming | 02 |
| **2** | Classes, Object, and Method | 04 |
| **3** | Constructor | 02 |
| **4** | Inheritance | 02 |
| **5** | Method overloading and method overriding | 02 |
| **6** | Interface | 02 |
| **7** | Nested classes and abstract classes | 02 |
| **8** | Collection frameworks | 04 |
| **9** | Exception handling | 02 |
| **10** | Packages | 02 |

**References –**

**Text Books:**


- M.T. Somashekara, D.S. Guru, K.S. Manjunatha, "Object Oriented Programming with Java", Kindle Edition, PHI Publication.
- Rajkumar Dr.Buyya, "Object Oriented Programming with Java: Essentials and Applications".

- Dr. Ms. Manisha Bharambe, Ms. Manisha Gadekar, "OBJECT ORIENTED PROGRAMMING USING JAVA 1", Kindle Edition, Nirali Publication.

**Reference Books:**

- Deitel and Deitel, "Java How to Program", Prentice Hall.
- Niemeyer &Leuck, "Learning Java", O'REILLY (SPD).

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**T. Y. B. Tech. Syllabus**
To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T. Y. B.Tech.** | Semester-V |
|---|---|
| Course Code: **MEMD307** | Course Name: **Design and Prototyping** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | - | -- | 2 |

**Course Description:**
This course provides students with practical experience in computer-aided design (CAD), focusing on sketching, part design, and the simulation and execution of additive manufacturing processes. Students will engage in hands-on activities that culminate in the 3D printing of their designed components.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Use CAD software to create detailed CAD models and designs.
2. Explain the workflow and settings for effective additive manufacturing.
3. Simulate the 3D printing process to identify and correct potential issues before actual printing.
4. Print a 3D component based on CAD models.

**Prerequisites:** Basic knowledge of engineering drawing and design principles

**Course Content**

| Unit No | Description | Hrs. |
|---|---|---|
| 1. | **Introduction to CAD and Sketcher Basics** Overview of CAD software, Basic operations and navigation, creating simple sketches and applying dimensions. | 02 |
| 2. | **Advanced Sketching Techniques** Using geometric constraints, Parametric sketching techniques, Practice exercises on complex shapes. | 02 |
| 3. | **Basic Part Design** Extruding and revolving sketches, Introduction to editing features like fillets, chamfers, and shells. | 02 |
| 4. | **Advanced Part Design** Applying advanced features and reference geometries, Transformation feature-Patterning, Scaling, Mirror, Creating assemblies from multiple parts. | 02 |
| 5. | **Introduction to Simulation in Additive Manufacturing** Basic principles of simulation for 3D printing, Setting up a simulation from a CAD model. | 02 |
| 6. | **Simulation for Material Optimization and Strength** | 02 |

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|---|---|---|
| | Using simulation to predict material usage and optimize print parameters, analyzing results and making adjustments. | |
| 7. | **Preparing for 3D Printing**<br>Converting CAD models to printable files (slicing), Selection of materials, Hands-on setup and initialization of 3D printers, sample 3D Printing of Components, Techniques for cleaning and finishing 3D printed parts. | **02** |
| 8. | **Project - 3D Printing of Components**<br>Selection of component, CAD design, simulation, 3D printing of designed parts, Post-Processing and Evaluation of Printed Components. | **06** |

**References-**

**Text books:**

- Engineering Design and Graphics with SolidWorks by James D. Bethune
- Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Ian Gibson, David Rosen, and Brent Stucker.

**Reference Books:**

- The 3D Printing Handbook: Technologies, design and applications" by Ben Redwood, Filemon Schöffer, and Brian Garret.

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T.Y. B. Tech** | Semester-**V** |
|---|---|
| Course Code: **MCMD303** | Course Name: **Industrial Automation** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | - | -- | 2 |

**Course Description:**
To provide a clear view on Programmable Logic Controllers (PLC) & to learn the various methods involved in automatic control and monitoring & to familiarize with the communication protocol this course has been inducted.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Explore the architecture of PLC and its functions.
2. Execute the various instructions and logic in PLC.
3. Develop the PLC program for various applications.
4. Design and develop the SCADA, DCS system for various applications.

**Prerequisite:** Knowledge of fundamentals of Mechatronics

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| 1. | **PROGRAMMABLE LOGIC CONTROLLERS**<br>Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section - Analog I/O modules - digital I/O modules CPU processor memory module - PLC programming Simple instructions - Output control devices - Latching relays PLC ladder diagram, | 04 |
| 2. | **INSTRUCTIONS**<br>Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters. | 04 |
| 3. | **APPLICATION OF PLC**<br>Traffic light control, 24-hour clock design, Automatic stacking process, temperature control, Automatic control of warehouse door, | 04 |
| 4. | **NETWORKING OF PLC AND SCADA**<br>Networking of PLCs-Data Communication-Fieldbus, PROFI bus, and Mod bus-OSI. Supervisory Control and Data Acquisition-Architecture. | 04 |
| 5. | **DISTRIBUTED CONTROL SYSTEM** | 04 |

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|---|---|---|
| | Architectures - Comparison - Local control unit, Operator interfaces - Low level and high-level operator interfaces - - Low level and high-level engineering interface | |
| 6. | **APPLICATIONS OF DCS**<br>Pulp and paper environment -Power plant - Petroleum - Refining environment, Wireless control system in challenging environments like welding shops, Introduction to Soft PLC. | 04 |

**References -**


- Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Lucas, M.P., Distributed Control System, Van Nonstrandreinhold Co. NY.
- Webb, John W. Programmable Logic Controllers: Principles and Application, Prentice Hall of India, New Delhi.
- Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, ISA Publication. Bolton, "Programmable Logic Controllers" Newnes.


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| Class:- **T. Y. B. Tech.** | Semester-**V** |
|---|---|
| Course Code: **AIMD303** | Course Name: **Business Intelligence** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | - | - | 2 |

**Course Description:**
This course is very useful as it aims in applying statistical techniques for analyzing data to help managerial people make informed decisions. It covers data preprocessing, modeling and visualization tasks thoroughly to give insight into the life cycle of a BI task. It makes students explore various analysis techniques which are also studied in various advanced data management related courses.

**Course Learning Outcomes:**
1. Articulate data pre-processing techniques.
2. Analyze the data modeling required for business intelligence related tasks.
3. Determine the role of statistical techniques in data analysis tasks.
4. Identify big data analysis techniques.
5. Utilize different reporting/visualization tool.

**Prerequisites:** Database Management Systems, Basic Probability and Statistics

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>What is business intelligence (BI)? Need for BI. Drawing insights from data: DIKW pyramid, levels of decision making (strategic, tactical and operational BI). Examples of business analyses--funnel analysis, distribution channel analysis and performance analysis. | 05 |
| 2. | **Data Preprocessing**<br>Notion of data quality. Typical preprocessing operations: combining values into one, handling incomplete/incorrect/missing values, recoding values, subsetting, sorting, transforming scale, determining percentiles, removing noise, removing inconsistencies, transformations, standardizing, normalizing-min-max normalization, score standardization. | 04 |
| 3. | **Inferential Statistics**<br>Role of probability in analytics, probability distributions and their characteristics. Need for sampling, generating samples, sampling and non-sampling error. Sampling Distribution of Mean, Central Limit Theorem, Standard Error. Estimation: Point and Interval Estimates, Confidence Intervals, level of confidence, sample size. | 04 |

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|---|---|---|
| **4.** | **Data Warehousing**<br>What is a data warehouse, need for a data warehouse, architecture, data marts, OLTP vs OLAP, Multidimensional Modeling: Star and snow flake schema, Data cubes, OLAP operations, Data Cube Computation and Data Generalization, Data Lake. | 04 |
| **5.** | **Enterprise Reporting**<br>Metrics, Measurement, Measures, KPIs, Dashboards, Reports, Scorecards | 03 |
| **6.** | **Hypothesis Testing**<br>Basic concepts, Errors in hypothesis testing, Power of test, Level of significance, p-value, general procedure for hypothesis testing. Parametric and non-parametric tests–ztest, ttest, chi-square test. Two tailed and one-tailed tests. Chi-square test for independence and goodness offit. ANOVA | 04 |

**References -**

**Text Books:**

- Business Analytics by James R Evans, Pearson
- Data Mining: Concepts and Techniques", Jiawei Hanand Micheline Kamber, Morgan Kaufman, ISBN978-81-312-0535-8, OLAP and cube technology, data preprocessing
- Fundamentals of Business Analytics", by R. N. Prasad, Seema Acharya, ISBN: 978-81-256-3203-2, Wiley-India – Types of Digital Data, OLTP-OLAP, Introduction to BI
- Business Analytics for managers, Wolfgang Jank – exploring and discovering Data Modeling

**Reference Books:**

- Business Intelligence for Dummies
- Applied Business Statistics: Making Better Business Decisions (English) by KenBlack, WileyIndia
- Forecasting: Principles and Practices, Rob J Hyndman, George Athanasopoulos, Otext

| Class: **T. Y. B. Tech.** | Semester: **V** |
|---|---|
| Course Code: **RAMD305** | Course**: Robot Programming** |

| L | T | P | Credits |
|---|---|---|---|
| 1 | -- | 2 | 2 |

**Course Description:**
This course provides a comprehensive introduction to robot programming techniques and control strategies. Students will learn how to program robots to perform various tasks autonomously and interact with their environment using robot operating system.
This course covers Robot programming fundamentals, motion planning and control, Robot simulation and testing.

**Course Outcomes:**
After the successful completion of this course, the student should be able to:
1. Explain Robot programming ecosystem.
2. Create reusable code for robot powered applications.
3. Design a custom robot using programming.
4. Simulate and control the robot using ROS.

**Prerequisite:** Knowledge in C++ and/or Python Programming language. Linux, Robot kinematics and Dynamics.

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction**<br>Robot Programming: Methods of robot programming. Categories of Robot programming languages. Robot programming Language Structure. Functions in Robot programming Language. | **03** |
| **2.** | **Robot Operating System (ROS)**<br>Introduction of ROS. Benefits of ROS. ROS history. Features of ROS. ROS applications. ROS1 and ROS2 comparison. ROS functionalities, ROS structure, Distribution, Tools, Architecture, Philosophy. | **03** |
| **3.** | **Robot Operating System (ROS)**<br>ROS workspace, Nodes, Packages, Topics. The ROS Graph. ROS interface, Service. | **03** |
| **4.** | **Block-based coding**<br>Working of block-based coding, features of block-based coding, designing interface, block-based coding with robots. Block based programming languages. | **03** |

**List of experiments (Any 10)**

| Course Content | | |
|---|---|---|
| **Expt. No.** | **Description** | **Hrs.** |
| **1.** | Introduction to Robot Programming (ROS). | **02** |
| **2.** | ROS Nodes, Topics, Services, Parameters, Launch Files | **02** |
| **3.** | ROS Workspace and ROS Package. | **02** |
| **4.** | Unified Robotic Description Format (URDF) for robot | **02** |
| **5.** | Links, Joints, Collisions, Inertia tags in the URDF file | **02** |
| **6.** | Launch file to Start the Robot State Publisher with URDF (XML) | **02** |
| **7.** | XML using Python launch files | **02** |
| **8.** | Make the URDF Compatible with Xacro. | **02** |
| **9.** | Functions with Xacro Macros. | **02** |
| **10.** | Motion in ROS. | **02** |
| **11.** | Computer vision in ROS with open CV | **02** |
| **12.** | Connecting Hardware with ROS | **02** |

**References Books:**

1. Robot Operating System for Absolute Beginners by Lentin Joseph
2. Programming Robots with ROS Morgan Quigley, Brian Gerkey, and William D. Smart.
3. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice-Hall.
4. S. K. Saha, Introduction to robotics, The McGraw Hill Company.
5. K.S. Fu; Gonzalez, R.C. & Lee, C.S.G, Robotics-Control, Sensing, Vision and Intelligence, McGraw Hill.

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| Class: **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI321** | Course Name: **Web Technology Lab** |

| L | T | P | Credits |
|---|---|---|---|
| - | - | 4 | 2 |

**Course Description:**
This lab course introduces students to modern web application deployment practices using DevOps tools. Students will learn to containerize applications with Docker, automate builds using CI/CD pipelines, and deploy apps on cloud platforms like Heroku and Netlify. The course also covers basic monitoring, logging, and reverse proxy configuration to simulate real-world deployment environments.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Build and containerize full-stack web applications using Docker.
2. Automate testing and deployment using CI/CD tools.
3. Deploy web applications on cloud platforms.
4. Configure reverse proxies and load balancing using NGINX.
5. Analyze application performance and record health metrics using open-source DevOps tools.

**Prerequisite:**
- Basic knowledge of HTML, CSS, and JavaScript,

**Course Content**

| Experiment No | Description | Hrs |
|---|---|---|
| 1. | Create a simple app using HTML, CSS, and JavaScript or Node.js/Flask with validation. | 04 |
| 2. | Install Docker and run a simple "Hello World" container. Understand basic Docker commands. | 02 |
| 3. | Create a Dockerfile for the web app and build/run it inside a Docker container. | 02 |
| 4. | Use Docker Compose to link web app with a database (e.g., MongoDB/MySQL). | 02 |
| 5. | Deploy the containerized app on Heroku, Netlify, or Vercel. | 02 |
| 6. | Configure Jenkins Pipeline for auto build/test/deploy of app. | 02 |
| 7. | Use NGINX as reverse proxy to serve and load balance the app. | 02 |

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|---|---|---|
| 8. | Implement logging with Winston/Morgan or Flask-Logging. | 02 |
| 9. | Monitor app metrics with Prometheus and visualize with Grafana. | 02 |
| 10. | Perform basic application security testing using OWASP ZAP. | 04 |

**References -**

**Text Books:**


- K. Chandramouli, "DevOps: Continuous Delivery, Integration, and Deployment with DevOps", Dreamtech Press.
- Mitesh Soni, "DevOps for Web Development", Packt Publishing.


**Reference Books:**


- Karl Matthias, Sean P. Kane, "Docker: Up and Running", O'Reilly Media.
- Gene Kim, Jez Humble, Patrick Debois, John Willis, "The DevOps Handbook", IT Revolution Press.


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| Class: **T. Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI313** | Course Name: **Deep Learning Lab** |

| L | T | P | Credits |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Description:**
Deep learning is a sub-field of machine learning that focuses on learning complex, hierarchical feature representations from raw data. The dominant method for achieving this, artificial neural networks, has revolutionized the processing of data (e.g. images, videos, text, and audio) as well as decision-making tasks (e.g. game-playing). Its successhas enabled a tremendous amount of practical commercial applications and has had a significant impact on society.

**Course Learning Outcomes:**
Upon the Successful Completion of the Course, the Students would be able to:
1. Implement ANN models for classification and prediction with parameter tuning.
2. Develop deep learning models for multiclass classification and sentiment analysis.
3. Apply and compare object detection techniques using traditional approaches.
4. Design CNN and YOLO models for advanced object detection tasks

**Prerequisites:**
- Python Programming, Machine Learning.

**It should consist of minimum 8-10 experiments based on the syllabus and experimentlist mentioned below.**

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| 1 | Installation of visual studio environment for python in addition to spider IDE. | 02 |
| 2 | Using Keras for visualizing wine types dataset.<br>-Read data and visualize data, plotting of data using histogram. | 02 |
| 3 | Using Keras for visualizing wine types dataset.<br>- Parameter relationships to visualize. | 02 |
| 4 | DL using tensorflow for predicting wine types data. | |
| 5 | Building ANN model for Wine Quality Prediction Using Deep Learning. Design Variation of ANN by Changing hidden layers in model. | 02 |

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|---|---|---|
| 6 | Build a Multiclass classifier using keras with TensorFlow. Use MNIST or any other suitable dataset. | 02 |
| 7 | Write a program for Sentiment Analysis using LSTM. | 02 |
| 8 | Implement a simple deep learning-based object detector, using:<br>1. Sliding windows.<br>2. Image pyramids.<br>3. Non-maxima suppression.<br>4. Batch processing. | 02 |
| 9 | Implement a CNN for object detection in the given image. | 02 |
| 10 | Implement Yolo for object detection. | 02 |

**References -**

**Text Books:**

- Ian Goodfellow Yoshua Bengio Aaron Courville, "Deep Learning", MIT Press.
- Michael Nielsen, "Neural Networks and Deep Learning", Determination Press.
- Bengio, Yoshua, "Learning deep architectures for AI".

**Reference Books:**

- N D Lewis, "Deep Learning Step by Step with Python".
- Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach,", O'Reilly Media.
- Umberto Michelucci, "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks,", Apress.
- Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher.
- Antonio Gulli, Sujit Pal, "Deep Learning with Keras,", Packt Publishers.

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| Class:- T. Y. B. Tech. | Semester- V |
|---|---|
| Course Code: AI315 | Course Name: Big Data Analytics Lab |

| L | T | P | Credits |
|---|---|---|---|
| 1 | - | 2 | 2 |

**Course Description:**
The explosion of social media and the computerization of every aspect of social and economic activity resulted in creation of large volumes of mostly unstructured data: web logs, videos, speech recordings, photographs, e-mails, Tweets, and similar. In a parallel development, computers keep getting ever more powerful and storage ever cheaper. Today, we have the ability to reliably and cheaply store huge volumes of data, efficiently analyze them, and extract business and socially relevant information. The key objective of this course is to familiarize the students with most important information aspects of Big Data attributes, its organization and analysis. The course is intended to build up necessary background for understanding the dynamics ofdata formats, different types and processing technologies. Moreover, it will assist to formulate the organizational and architectural aspects of big data in NoSQL sense. This course has much importance to analyze the usage of big data in association with advance applications.

**Course Learning Outcomes:**
Upon the Successful Completion of the Course, the Students would be able to:
1. Identify and investigate the distributed underlying experimental bed of Hadoop.
2. Compare the usage of map-reduce paradigm for parallel execution.
3. Recognize the nosql prototype to build the big data management.
4. Apply the skills to construct nosql designs and its manipulation.
5. Visualizing business benefits from unstructured data analysis.

**Prerequisites:** Database engineering, Advance computing.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Big Data and Its Importance**<br>What is big data, why big data, Convergence of key trends, Expanding universe of Unstructured data, Industry examples of big data Digital marketing, Fraud and big data, Risk and big data, Credit risk management, big data and algorithmic trading, big data and healthcare, Advertising and big data. | 03 |
| 2. | **Hadoop and Map-Reduce**<br>Hadoop ecosystem, Design of Hadoop distributed file system (HDFS), Anatomy of MapReduce job run, Classic Map-reduce, YARN, Analyzing data with Hadoop. | 03 |
| 3. | **NoSQL Data Management** | 03 |

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| | | |
|---|---|---|
| | Introduction to NoSQL, Emergence of NoSQL, Aggregate data models, Key-value and document data models, Column-family stores, Graph databases, Schemaless databases, Distribution models, CAP Theorem. | |
| 4. | **Big Data Technology**<br>Big Data details, Expanding universe of Unstructured data, Industry examples, World of parallel processing – Hadoop, Open-Source technologiesand big data, Cloud and big data, Mobile business intelligence, Crowdsourcing analytics. | 03 |

**It should consist of a minimum 8-10 experiments based on the syllabus And experiment list mentioned below**

| Course Content | | |
|---|---|---|
| **Experiment No** | **Description** | **Hrs** |
| 1 | Install, configure and run python, NumPy and Pandas. | 04 |
| 2 | Install, configure and run Hadoop and HDFS. | 02 |
| 3 | Visualize data using basic plotting techniques in Python. | 02 |
| 4 | Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB. | 04 |
| 5 | Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB. | 04 |
| 6 | Implement word count / frequency programs using MapReduce. | 02 |
| 7 | Implement a MapReduce program that processes a dataset. | 04 |
| 8 | Implement clustering techniques using SPARK. | 02 |

**References -**

**Text Books:**


- Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: EmergingBusiness Intelligence and Analytic Trends for Today's Businesses", Wiley Publication.
- Tom White, "Hadoop: The Definitive Guide", Oreily Media.
- Seema Acharya, Subhasini Chellappan, "Big Data Analytics", Wiley.


**Reference Books:**


- Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", Pearson Education.


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- Chris Eaton, Dirk derooset al., "Understanding Big data", McGraw Hill.
- E. Capriolo, D. Wampler, J. Rutherglen, "Programming Hive", O Reilley.
- Lars George, "HBase: The Defenitive Guide", O reilly.
- Alan Gates, "Programming Pig", O Reilly.

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| Class: - **T. Y. B. Tech** | Semester-V |
|---|---|
| Course Code: **AI323** | Course Name: **AI for Edge Devices Lab** |

| L | T | P | Credits |
|---|---|---|---|
| -- | -- | 2 | 1 |

**Course Description:**
This lab course introduces students to deploying AI and ML models on edge devices using TinyML. It covers data collection, model training, optimization, and microcontroller deployment. Students will work on real-time applications like gesture recognition and anomaly detection. The course emphasizes practical, hands-on skills for AI-powered IoT solutions.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Install and configure TinyML tools and frameworks for AI model development on edge devices.
2. Collect real-time sensor data and train lightweight AI models for classification and detection tasks.
3. Deploy and optimize AI models on microcontrollers using quantization and pruning techniques.
4. Develop and demonstrate real-time AI applications on edge devices such as keyword spotting, gesture recognition, and anomaly detection.

**Prerequisite:**

- To provide hands-on experience in deploying AI/ML models on microcontrollers and edge devices using TinyML frameworks.
- To enable students to collect, preprocess, and utilize real-time sensor data for AI-based applications.
- To develop skills in optimizing, deploying, and testing lightweight AI models for real-time edge-based decision-making systems.

**Course Content**

| Experiment No | Description | Hrs |
|---|---|---|
| 1. | Introduction to TinyML Tools: Install and configure TensorFlow Lite for Microcontrollers, Arduino IDE, and Edge Impulse platform. | 02 |
| 2. | Implement a Hello World ML model (sine wave approximation) on a microcontroller (e.g., Arduino Nano 33 BLE Sense or ESP32). | 02 |

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|---|---|---|
| **3.** | Collect sensor data (accelerometer, microphone, temperature) using a microcontroller and visualize it using a serial monitor or Edge Impulse Studio. | **02** |
| **4.** | Train a Keyword Spotting Model (e.g., detect words like "yes" or "no") using Edge Impulse or TensorFlow Lite and deploy it on a microcontroller. | **02** |
| **5.** | Develop an Image Classification Model (basic object detection using pre-trained Mobile Net models) and test it on a compatible edge device with a camera module. | **02** |
| **6.** | Optimize a trained AI model for edge deployment using model quantization and pruning techniques. | **02** |
| **7.** | Create a gesture recognition system using accelerometer data from a microcontroller and deploy a trained TinyML model. | **02** |
| **1.** | Implement a real-time anomaly detection model (e.g., vibration anomaly detection using a sensor) on a microcontroller. | **02** |
| **2.** | Interface a microcontroller with IoT platforms (e.g., Blynk, ThingSpeak) and display AI inference results from the edge device. | **02** |
| **3.** | Mini-Project: Develop and deploy an end-to-end TinyML application (e.g., smart home controller, wearable health monitor, voice-based command system). | **02** |

**References -**

**Text Books:**


- Pete Warden, Daniel Situnayake, "TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers", O'Reilly Media.
- Anirudh Koul, Siddha Ganju, Meher Kasam, "Practical Deep Learning for Cloud, Mobile, and Edge", O'Reilly Media.
- Tang Lee, "Edge AI: Machine Learning for Embedded Systems", Apress.


**Reference Books:**


- Gian Marco Iodice, "TinyML Cookbook", Packt Publishing.
- Rohit Sharma, "Introduction to TinyML", BPB Publications.
- Anirudh Koul, Siddha Ganju, Meher Kasam, "Practical Deep Learning for Cloud, Mobile, and Edge", O'Reilly Media.

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: **T. Y. B. Tech.** | Semester-V |
|---|---|
| Course Code: **AI3191** | Course Name: **Summer Internship/ Professional Certification** |

| L | T | P | Credits |
|---|---|---|---|
| -- | -- | -- | 1 |

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Apply the theoretical and practical knowledge for product/service development.
2. Undergo real time IT Industry practices regarding product/service development.
3. Identify and analyze engineering problems to provide IT based solutions.
4. Adopt recent industry practices for project development.
5. Improve the ability to work in teams.
6. Enhance technical skills for solving complex engineering problems.

**General guidelines:**

**All the students who are enrolled for this course are required to complete**

1. **4 Weeks (30 Days Minimum) Industry internship**

**Or**

2. **Professional Certification/Online Course**

**Industry Internship**
1. It is mandatory that student should complete minimum 4 Weeks (30 Days) of internship in reputed IT Industry.
2. Student has to undergo internship in the industry verified by the department.
3. During the internship student has to follow all the guidelines given by department & Institute.
4. A mentor will be assigned to the student to whom the student needs to report regularly as per provided guidelines.
5. Mentor will have minimum 1 visit to the industry where the student is undergoing internship.
6. Internship can also be done in online/WFH mode if allowed by the company. In that case mentor will have an interaction with the industry person over any online meeting platform.

**Professional Certification/Online Course**
In the International Certification or online course, it is expected that the student should undergo training for minimum 36 Hrs. related to subject specialization and should submit the online course/certification completion certificate to the department.

**Evaluation:**
1. **Industry Internship**

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A student who has successfully completed the internship will be evaluated individually for his/her project work or services done in the industry by his mentor through the quality of work carried out. The evaluations will be carried out jointly with an external examiner preferably a mentor assigned to another student or a company expert.
The ISE evaluation of this summer internship will be carried out for 100%. The assessments will be carried out as per the rubrics given to the mentor. Student will submit hard copy of the internship report and internship completion certificate to the department.

**2. Professional Certification/Online Course**

A student who has successfully completed the certification will be evaluated individually for his/her certification done by his mentor through the quality of work carried out. The evaluations will be carried out jointly with an external examiner preferably a mentor assigned to another student or a company expert.
The ISE evaluation of this Professional Certification/Online Course will be carried out for 100%. The assessments will be carried out as per the rubrics given to the mentor. Student will submit the course completion certificate along with required documents to the department.

Note: If the certification or the online course has any qualification examination conducted by the platforms then the mentor will consider the 50% score achieved during the examination and 50% from his own evaluation.

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI325** | Course Name: **Massive Open Online Course (MOOC)-II** |

| L | T | P | Credits |
|---|---|---|---|
| - | - | - | 1 |

**Course Description:**
Online courses offered through platforms like NPTEL, SWAYAM, and NASSCOM provide Computer Science & Engineering (AI&ML) students with valuable opportunities to advance their understanding of modern computing concepts and technologies. These courses cover key domains such as algorithms and data structures, software engineering, database systems, operating systems, computer networks, cybersecurity, cloud computing, and emerging fields like Artificial Intelligence, Machine Learning, and Data Science. By combining strong theoretical foundations with hands-on practical applications, they help students enhance problem-solving abilities, work with state-of-the-art tools, and prepare for real-world, industry-oriented challenges. The objective of such courses is to cultivate skills and mindsets that encourage continuous learning, adaptability to new technologies, and readiness to thrive in an ever-evolving tech landscape.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Explain fundamental principles, core concepts, and commonly used technologies in computer science and engineering.
2. Analyze basic computing problems using mathematical reasoning and engineering principles, and develop algorithms to solve them effectively.
3. Design and implement simple computer programs and system components using standard programming languages and software tools, demonstrating an ability to test and debug them.

**Note:**
1. The student will get the credits of respective course in following conditions,
   In case of course selected from NPTEL/SWAYAM/NASSCOM platforms, students have to complete the timely assignments, pass the exam and secure the certificate.
2. While selecting online course, following points must be taken care of,
   a. Selected course must be approved by Departmental Programme Committee (DPC).
   b. Duration of each online course must be of at least FOUR weeks for NPTEL/SWAYAM & minimum 12 to 20 hours for NASSCOM.

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**References –**

**e-References :**

- NPTEL (National Programme on Technology Enhanced Learning)
  https://nptel.ac.in
- SWAYAM (Study Webs of Active Learning for Young Aspiring Minds)
  https://swayam.gov.in
- MOOCs on NASSCOM
  www.nasscom.in

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| Class:- **T.Y. B. Tech.** | Semester- **V** |
|---|---|
| Course Code: **AI327** | Course Name: **Mini Project - I** |

| L | T | P | Credits |
|---|---|---|---|
| - | - | 6 | 3 |

**Course Description:**
This course enables CSE (AI & ML) students to integrate the foundational knowledge acquired in core courses to design, develop, test, and evaluate a technology-based solution for a real-world problem. It emphasizes engineering design, systematic problem-solving, experimentation, debugging, and technical communication rather than merely developing a software application. Students are expected to justify design decisions using appropriate algorithms, data structures, system architecture, and software engineering principles; validate their solutions through testing and performance evaluation; and effectively document and present the engineering rationale behind their work.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Identify and analyze a real-world problem, and formulate appropriate software requirements using software engineering principles.
2. Design a modular software system by applying suitable algorithms, data structures, database models, and software engineering practices.
3. Develop and integrate a functional software prototype using appropriate programming tools, frameworks, and technologies.
4. Test, debug, and evaluate the software system using systematic testing methods, performance measures, and proper documentation.
5. Demonstrate effective teamwork, project management, technical documentation, and communication skills by presenting and defending the project's design decisions and implementation.

**Prerequisite:**
Programming Fundamentals, Data Structures and Algorithms, Software Engineering, Web Technologies, Database Management Systems.

**Course Content / General Guidelines:**

The Mini Project shall focus on engineering design, analysis, implementation, testing, and validation rather than merely developing a software application. It should demonstrate integration of knowledge from core Computer Science and Information Technology courses such as Programming, Data Structures, Algorithms, Database Management Systems, Software Engineering, Computer Networks, and Web Technologies. Evaluation shall prioritize technical correctness, design rationale, software quality, testing, and documentation over interface aesthetics or feature count.

Each Mini Project must include the following deliverables:

- Problem Statement and Objectives

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- Software Requirement Specification (SRS)
- Workflow Diagram (Use Case / Activity / Flowchart)
- System Architecture Diagram
- Database Schema or Data Model
- API Specification (where applicable)
- Algorithm or Business Logic Explanation
- Source Code Repository with Version History (Git)
- Test Plan, Test Cases, and Test Results
- Debugging Log documenting identified issues, root causes, corrective actions, and outcomes
- Deployment / Installation Guide

Final Project Report and Presentation

| Course Activities | | |
|---|---|---|
| **Week No** | **Description** | **Hrs** |
| **1** | Course orientation, team formation, selection of project theme, identification of foundational courses, problem definition. | **06** |
| **2** | Requirement analysis, Software Requirement Specification (SRS), Foundation Integration Map, project planning. | **06** |
| **3** | System design - use case / activity diagrams, system architecture diagram, Review-I (Theme & SRS Approval). | **06** |
| **4** | Detailed design - database schema / data model, API specification, module identification. | **06** |
| **5** | Algorithm / business logic design, technology stack finalization, coding standards, Review-II (Design & Architecture). | **06** |
| **6** | Module-wise development (Sprint 1), version control setup (Git repository), unit testing. | **06** |
| **7** | Module-wise development (Sprint 2), unit testing, Review-III (Implementation Progress). | **06** |
| **8** | System integration, integration testing, debugging log maintenance. | **06** |

| | | |
|---|---|---|
| 9 | Test plan execution, test case documentation, performance evaluation, Review-IV (Testing & Validation). | 06 |
| 10 | Bug fixing, performance improvement, error analysis, deployment / installation guide preparation. | 06 |
| 11 | Final report writing, documentation compilation, mock presentation, viva preparation. | 06 |
| 12 | Final demonstration, report submission, presentation, individual viva-voce and Final Review. | 06 |

**References -**

**Text Books:**


- Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw-Hill Education.
- Ian Sommerville, Software Engineering, Pearson Education.


**Reference Books:**


- Martin Fowler, UML Distilled: A Brief Guide to the Standard Object Modeling Language, Addison-Wesley.
- Robert C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, Prentice Hall.


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| Class: - **T. Y. B. Tech.** | Semester – **V** |
|---|---|
| Course Code: **SH3035** | Course Name: **Scholastic Aptitude - I** |

| **L** | **T** | **P** | **Credits** |
|---|---|---|---|
| **2*** | **-** | **-** | **Audit** |

**Course Description:**
Quantitative and Reasoning tests form a major part of most of the competitive exams and recruitment processes. They evaluate numerical ability and problem solving skills of candidates. Along with the arithmetic abilities, candidate's patience while reading through the question is also tested. Decision making is also a crucial part of the process with a question having multiple solutions and the candidate has to choose the most efficient one. Fast calculations have become an integral part of a candidate's career. Calculating the remuneration and efficiency, estimating profits and interests on the principal, using a logical approach towards solving a problem is now a routine affair for a professional.

**Course Learning Outcomes:**

After successful completion of the course, students will be able to:

1. Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.
2. Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests.
3. Develop a bridge in analogies, series and visualizing directions.
4. Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and campus recruitment exams.

**Prerequisites:**
- Fundamentals of various Mathematical and Arithmetic operations, Calculations.

**Course Content**

| Unit No | Description | Hrs. |
|---|---|---|
| 1 | **Number System, HCF, LCM**<br>Basics, Base System, Exponents, LCM and HCF, Factors, Cyclicity, Different Methods to find LCM-HCF, HCF-LCM relation, Applications of HCF –LCM. | 03 |
| 2 | **Percentage**<br>Understand Conversion, Single change, Successive change, Product Stability, Applications of percentage. | 02 |

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|---|---|---|
| 3 | **Average, Allegations**<br>Weighted average, Concept of average speed & allegation, applications of Average & mixture allegation. | 02 |
| 4 | **Ratio & Proportion**<br>Comparison of Ratio & fraction, Properties of Ratio & Proportion, Mean Proportion. Joint ratio. | 02 |
| 5 | **Profit & Loss**<br>Same selling price different Cost Price, Same cost price different selling price Concept of false scale. | 02 |
| 6 | **Simple interest -Compound interest**<br>Basics, Difference between SI CI, Conversion Periods, Depreciation. | 02 |
| 7 | **TRW, Pipes & Cisterns**<br>Time, Rate and Work-Unitary Method, LCM Method, Calculation of remuneration. Pipes & Cisterns -Concept of negative work, LCM Method. | 02 |
| 8 | **Blood Relations**<br>Blood Relations -Symbols, generation of tree diagram, types of questions-pointing towards person, tree based, coded blood relation. | 02 |
| 9 | **Numerical Analogy**<br>Basics, Relation between two numbers, numerical. | 02 |
| 10 | **Pattern, Step Completion**<br>Image completion, Mirror images, Water images, input-Output. | 02 |
| 11 | **Series Completion**<br>Types of series, Number series pattern, Letter series, Alphanumeric series. | 02 |
| 12 | **Direction Sense**<br>Basics, shadow-based concept, Concept of local time zone (IST, GMT, Longitude, Latitude), Problems on local time difference, Coded direction sense. | 02 |
| 13 | **Coding Decoding**<br>Letter-Letter, Letter- Number, Number-Number, Letter-Symbol, Mixed Coding. | 03 |

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|---|---|---|
| 14 | **Syllogism**<br>Basics, Types of Statements, Different diagram for different statements, Types of Questions-Based on Conclusion, Based on Statements. | 02 |
| | **Total Hrs.** | 30 |

**References -**

**Reference Books:**


- R. S. Aggarwal, "Quantitative Aptitude", S Chand Publishing, New Delhi.
- R. S. Aggarwal, "Logical Reasoning", S Chand Publishing, New Delhi.
- Arun Sharma, "Quantitative Aptitude", McGraw Hill Publishing, New Delhi.
- Arun Sharma, "Logical Reasoning", McGraw Hill Publishing, New Delhi.

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| Class: - **T. Y. B. Tech.** | Semester - **VI** |
|---|---|
| Course Code: **AI304** | Course Name: **Automata Theory** |

| **L** | **T** | **P** | **Credits** |
|---|---|---|---|
| **3** | **-** | **-** | **3** |

**Course Description:**
Finite Automata and Formal Languages is a foundational course in computer science that explores the theoretical aspects of computation. The course focuses on the study of finite automata, which are mathematical models used to describe and analyze the behavior of computational systems. Students will learn about regular languages, their properties, and the construction of deterministic and non-deterministic finite automata push down automata and Turing machine. Through theoretical discussions and exercises, students will develop a solid understanding of the fundamental concepts underlying computation, concrete the way for advanced topics in algorithm design, programming languages, and compiler construction. This course also provides a comprehensive understanding of compilers, which are essential software tools that translate high-level programming languages into executable code. They will also learn about programming language grammars, parsing techniques, symbol tables etc.

**Course Learning Outcomes**
After successful completion of the course, strudels will be able to:
1. Solve automata problems using mathematical theorems and techniques.
2. Design computational models for different language classes.
3. Construct grammar or regular expressions for different language classes.
4. Prove and disprove key properties of formal languages and automata.
5. Create a compiler using various tools like LEX and YACC.

**Prerequisites:**
- Understanding of basic computer science concepts, Discrete Mathematics.
- Programming principles, and problem-solving techniques.

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction to Finite Automata and Regular Languages**<br>Overview of Formal Languages and Automata Theory, Chomsky Hierarchy, Finite Automata, Formal Definition, Representation and notation of finite automata, DFA, NFA, Null-NFA, Minimization of DFAs, Definition of regular languages, Regular expression, Closure properties of regular languages. Equivalence between NFAs and DFAs, Kleens Theorem-I, | **06** |

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|---|---|---|
| | Kleens Theorem-II and Finite Automata and Regular Language Applications. | |
| 2. | **Context-Free Grammars and Pushdown Automata**<br>Context free grammars and languages, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Forms, ParseTress, Ambiguity in Grammars and Languages, Left recursion and left factoring in context free grammars, Simplification of CFG, Applications of Context-Free Grammars. Formal Description of PDA, String Acceptance by Empty Stack and Acceptance by Final State, Non-deterministic Pushdown Automata, Equivalence of context free grammars and pushdown automata. | 06 |
| 3. | **Normal Forms and properties for Context- Free Grammars**<br>Pumping Lemma for Regular Languages, Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages, Normal Forms for Context- Free Grammars, Chomsky Normal Form (CNF), Griebech Normal Form (GNF). | 06 |
| 4. | **Turing machine**<br>Introduction to Turing Machine, Formal Description, Instantaneous description, Design of Turing machines, Types of Turing Machine: Non-deterministic TuringMachine, Universal Turing Machine, Multi-tape Turing Machine, Enumeration and oracle Turing machines, Undecidable problems and Halting problem. | 06 |
| 5. | **Introduction To Compiler**<br>Overview of Compilers, Phases of a Compiler. **Lexical Analysis:** The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A language for specifying Lexical Analyzers (LEX).<br>**Syntax Analysis:** The role of the Parser, First and Follow, Predictive Parsing, LR Parsers-SLR, Canonical LR, LALR, Parser Generator (YACC). | 07 |
| 6. | **Syntax-Directed Translation and Intermediate Code Generation**<br>Syntax-Directed Translation: Syntax-Directed Definition, S-Attributed SDD, L-Attributed SDD, Translation Schemes. Intermediate Code Generation: Intermediate Languages- Graphical Representations, three address code, Implementations. optimization techniques. | 07 |

**References-**

**Text Books:**


- John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata TheoryLanguages and Computation", Pearson Education.
- Alfred Aho, Monica S Lam, RaviSethi, Jeffrey D. Ullman, "Compilers- Principles Techniques and Tool", Pearson Education India.

**Reference Books:**


- Peter Linz, "An introduction to Formal Languages and Automata", Jones & Bartlett.
- Michel Sipser, "Introduction to Theory of Computation", Thomson.
- V.Raghavan, "Principles of Compiler Design", McGrawHillEducation.


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| Class: - **T. Y. B. Tech.** | Semester - VI |
|---|---|
| Course Code: **AI306** | Course Name: **Research Methodology** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | - | - | 2 |

**Course Description:**
- Research Methodology is designing and adhering to the appropriate methodology throughout for improving the quality of research.

**Course Learning Outcomes:**

After successful completion of the course, strudels will be able to,
1. Utilize the basic concepts of Research Methodology.
2. Apply the methodology, irrespective of their discipline, in developing the most appropriate methodology for their research studies.
3. Analyze the art of using different research methods and techniques.
4. Develop the spirit of scientific inquiry in the students.

**Prerequisites:**
- Basic knowledge of logical reasoning.
- Probability theory.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Research Methodology: An Introduction**<br>Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology Research and Scientific Method, Research Process. | 04 |
| 2. | **Research Problem Techniques**<br>Criteria of Good Research, Problems Encountered by Researchers in India, what is a Research Problem? Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem. | 04 |
| 3. | **Research Design**<br>Meaning of Research Design, Need for Research Design, Research Methodology Features of a Good Design, Important Concepts Relating to Research Design,Different Research Designs, Basic Principles of Experimental Designs. | 04 |

| | | |
|---|---|---|
| 4. | **Sampling Design, Measurement and Scaling Techniques**<br>Implications of a Sample Design, Steps in Sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Typesof Sample Designs, Measurement in Research, Measurement Scales, Meaning ofScaling, Scale Construction Techniques. | **04** |
| 5. | **Methods of Data Collection, Processing and Analysis of Data**<br>Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Processing Operations, Some Problems in Processing, Elements of Analysis, Statistics in Research. | **04** |
| 6. | **Interpretation and Report Writing**<br>Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. | **04** |

**References**

**Text Books:**


- CR Kothari, "Research Methodology Methods and techniques", New Age International Publishers.


**Reference Books:**


- John W.Creswell, "Research Design: Qualitative, Quantitative, and Mixed Methods Approaches".
- Sharan B. Merriam,Elizabeth J. Tisdell, "Qualitative Research: A Guide to Design and Implementation".
- William M. K. Trochim, James P. Donnelly, "The Research Methods Knowledge Base".

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| Class: - **T. Y. B. Tech.** | Semester – **VI** |
|---|---|
| Course Code: **AI308** | Course Name: **Smart Cities** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
IoT is regarded as the significant frontier that can improve almost all activities in our lives. Most of the devices, which have not previously been connected to the internet, can be networked and respond the same way as smart devices, in Smart Cities.

**Course Learning Outcomes:**
After successful completion of the course, strudels will be able to
1. Describe the concepts, need, and applications of IoT across smart domains.
2. Optimize resources for different IoT applications like Smart Cities.
3. Analyze real world IoT Design constraint in system development.
4. Design secure IoT systems with cloud/fog integration for Smart City applications.

**Prerequisites:**
The students will require to participate actively in creative thinking exercises. IOT is futuristic and will require students to understand other technologies and current uses where IOT can be integrated to make a make a quantum jump in the in the efficiencies in application.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction and Application to Internet of Things**<br>Need of IoT, Strategic Research and Innovation Directions, Future Internet Technologies, IoT Smart X Application: Smart Cities, Smart Energy & Smart Grid, Smart Mobility & transport, Smart Home, Smart Building & Infrastructure, Smart Factory & Manufacturing, Smart Health, Smart Logistics & Retails. | 06 |
| 2. | **Embedded Suite for IoT**<br>Introduction to Arduino and Raspberry Pi, Understanding the Arduino and Raspberry Pi board and its Components, recognizing the Input/output, GPIO connectivity. | 06 |
| 3. | **Wireless Technologies supporting IoT**<br>Protocol Standardization for IoT, Machine to machine (M2M) and WSN Protocols, Basics of RFID, RFID Protocols, Issues with Standardization, Protocols- IEEE 802.15.4, ZigBee, IPv6 technologies for IOT. | 06 |

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|---|---|---|
| 4. | **IoT Networking**<br>Star, Mesh, Tree, and Overview of networking Protocols: TCP/IP, 6LowPan, IoTDevices Application-Level Protocol Service parameter in MQTT, | 06 |
| 5. | **Cloud Analytics for IoT Application**<br>Introduction to cloud computing, Difference between Cloud Computing and FogComputing: The Next Evolution of Cloud Computing, Role of Cloud Computingin IoT, Connecting IoT to cloud, Cloud Storage for IoT Challenge in integration of IoT with Cloud. | 06 |
| 6. | **IoT: Privacy, Security & Governance**<br>Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT Platforms for Smart Cities, First Stepstowards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities. | 08 |

**References**

**Text Books**


- Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Ave sand, Sta matis Karnowski's, David Boyle, "From Machine to the Internet of Things: Introduction to a New Age of Intelligence", Academic Press. to the Internet of Things:
- Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications.
- Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Academic Press, (ISBN-13: 978-0124076846).


**Reference Books**


- Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing.
- Daniel Minoli John Wiley & Sons Building the internet of things with ipv6 and mipv6,The Evolving World of M2M Communications, ISBN: 978-1-118-47347-4.
- Cassimally, Hakim, "Designing the Internet of Things", Wiley Publications, ISBN 10:111843062X.
- Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", Apress Publication. (ISBN-13: 978- 1430257400).
- Moocs Links an additional reading material: www.nptelvideos.in.

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**T. Y. B. Tech. Syllabus**
To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T. Y. B. Tech.** | Semester – **VI** |
|---|---|
| Course Code: **AI310** | Course Name: **Augmented and Virtual Reality** |

| L | T | P | Credits |
|---|---|---|---|
| **3** | **-** | **-** | **3** |

**Course Description:**
This course delves into Augmented, Virtual, and Mixed Reality, providing a comprehensive exploration of their technologies and applications. Beginning with an in-depth introduction, students will grasp the taxonomy, features, and challenges of Augmented Reality, while discerning the distinctions between AR, VR, and MR. The course navigates through the architecture and hardware of VR systems, covering input devices like tracking systems and motion capture, along with output components such as visual displays. Stereoscopic vision, haptic rendering, and algorithms for rendering and parallax are explored, setting the stage for a practical understanding of VR and AR software development using leading platforms and toolkits. The curriculum concludes with a focus on 3D interaction techniques and the application of VR in digital entertainment, shedding light on its role in film, TV production, physical exercises, and games.

**Course Learning Outcomes:**

After successful completion of the course, students will be able to:

1. Identify and examine fundamental techniques and principles of AR and VR design and deployment.
2. Compare and justify appropriate design approaches for AR and VR applications.
3. Evaluate the benefits and drawbacks of specific AR and VR techniques.
4. Analyze AR and VR design challenges and explore potential solutions.

**Prerequisite:**

- A basic understanding of computer graphics.
- Programming fundamentals, and familiarity with 3D concepts.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| **1.** | **Introduction**<br>Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR, VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality. | **06** |
| **2.** | **VR systems** | **05** |

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|---|---|---|
| | VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware: VR input hardware: tracking systems, motion capture systems, datagloves, VR output hardware: visual displays. | |
| 3. | **Stereoscopic Vision & Haptic rendering**<br>Fundamentals of the human visual system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Algorithms for haptic rendering andparallax, Synthesis of stereo pairs, Pipeline for stereo images. | **06** |
| 4. | **VR and AR software development**<br>VR software development: Challenges in VR software development, Master/slaveand Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR). AR software development: AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit. | **07** |
| 5. | **3D interaction techniques**<br>3D Manipulation tasks, Manipulation Techniques and Input Devices, InteractionTechniques for 3D Manipulation. | **06** |
| 6. | **Application of VR in Digital Entertainment**<br>VR Technology in Film & TV Production. VR Technology in Physical Exercisesand Games. Demonstration of Digital Entertainment by VR. | **06** |

**References-**

**Text Books:**


- George Mather, "Foundations of Sensation and Perception: Psychology Press".
- Jason Jerald, "The VR Book: Human-Centered Design for Virtual Reality".


**Reference Book:**


- Tony Parisi, O' Reilly, "Learning Virtual Reality".
- Burdea, G. C. and P. Coffet. "Virtual Reality Technology", Wiley-IEEE Press.
- Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", MorganKaufmann.
- Alan Craig, William Sherman and Jeffrey Will, "Developing Virtual Reality Applications,Foundations of Effective Design", Morgan Kaufmann.


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| Class: - **T. Y. B. Tech.** | Semester - **VI** |
|---|---|
| Course Code: **AI312** | Course Name: **Wireless & Mobile Nets** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
Build an understanding of the fundamental concepts of wireless, mobile, ad hoc and Wireless Sensor Networks. Develop an understanding of different components of computer networks, various protocols, routing algorithms, modern technologies and their applications. Introduce the students to advanced networking concepts such as DWDM, WSNs, ATM and MPLS. Allow the student to gain expertise in some specific areas of networking such as Network designing and Management.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to.
1. Articulate fundamental concepts of Wireless, Mobile, Ad Hoc, Sensor, Optical and ATM networks operation.
2. Choose appropriate protocol for desired communication service.
3. Compare various types of routing protocols.
4. Evaluate advanced network technologies and network protocols.

**Prerequisites:** Basic computer network.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Wireless and Mobile Networks**<br>Wired communication system, wireless communication system- paging system, cordless telephone system, cellular mobile system, Bluetooth. Wireless Local, Area Network (WLAN), Wireless Generations-1G, 2G, 2.5G, 3G, 4G, 5G. Introduction to Cellular mobile Systems-GSM, CDMA. Cellular system design fundamental. | 06 |
| 2. | **Ad Hoc and Wireless Sensor Networks**<br>Ad Hoc Networks-Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols,Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV). Wireless Sensor Networks- Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN | 06 |

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|---|---|---|
| | application examples, Network Architecture. | |
| 3. | **Optical Networking**<br>SONET/SDH standards, Dense Wavelength division multiplexing (DWDM), Performance and design Considerations. | 06 |
| 4. | **ATM: The WAN Protocol**<br>Faces of ATM, ATM Protocol operations (ATM cell and Transmission) ATM Networking basics, Theory of Operations, B-ISDN reference model, PHY layer, ATM Layer (Protocol model), ATM layer and cell, Traffic Descriptor and parameters, Traffic Congestion control defined, AAL Protocol model, Traffic contract and QoS, User Plane overview, Control Plane AAL, Management Plane, Sub-DS3 ATM, ATM public services. | 06 |
| 5. | **Routing in the Internet**<br>Routing in the Internet: Intra and inter domain routing; Unicast Routing Protocols:RIP, OSPF, BGP; Multicast Routing Protocols: MOSPF, DVMRP, Drawbacks oftraditional routing methods, Idea of TE, TE and Different Traffic classes. IP over ATM, Multi-protocol Label switching (MPLS), Storage Area Networks (SAN). | 06 |
| 6. | **Network Management**<br>SNMP: Concept, Management Components, SMI, MIB, SNMP format, Messages, Backbone Network Design: Backbone Requirements, Network Capacities Topologies, Topologies Strategies, Tuning Network. | 06 |

**References**

**Text Books:**


- Darren L Spohn, "Data Network Design", TMH.
- Clint Smith and Daniel Collins, "Wireless networks: design and integration for LTE, EVDO,HSPA, and WiMAX", McGraw-Hill Education.


**Reference Books:**


- James F.Kurose, "Computer Networking: A Top-Down Approach featuring the Internet",
- Morgan Kaufman, Peterson and Davie, "Computer Networks: A Systems Approach", (ISBN: 155860832X).
- C. Siva Ram Murthy, B.S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols".


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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T. Y. B. Tech.** | Semester – **VI** |
|---|---|
| Course Code: **AI314** | Course Name: **Sentiment Analysis** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This comprehensive Sentiment Analysis course delves into the multifaceted realm of understanding and interpreting opinions within textual data. Beginning with a thorough Introduction, it explores theapplications and challenges of sentiment analysis, framing it within the context of mini-NLP. The subsequent chapters intricately cover Sentence Subjectivity and Classification, Sentiment Lexicon Generation, and the nuanced Analysis of Debates and Comments. Students will gain expertise in supervised and unsupervised sentiment classification, lexicon generation techniques, and advanced topics such as comparative analysis and intent mining. With a focus on real-world applications, including the detection of fake opinions and quality assessment of reviews, this course equips learners with a robust skill set in sentiment analysis, preparing them for the dynamic landscape of

**Course Learning Outcomes:**

After successful completion of the course, students will be able to:

1. Describe fundamentals, applications, and challenges of sentiment analysis.
2. Classify sentences and documents by sentiment and aspect polarity.
3. Generate sentiment lexicons using dictionary, corpus, and embedding methods.
4. Analyze debates and reviews to identify stances, intents, and fake opinions.
5. Evaluate sentiment models, review quality, and consider ethical aspects.

**Prerequisite:** Fundamental Understanding of NLP, Basic knowledge of Machine Learning.

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction to Sentiment Analysis**<br>Introduction, Applications of Sentiment Analysis, Research in Sentiment Analysis, Sentiment Analysis as Mini-NLP, The Problem of Sentiment Analysis,Definition of Opinion and Opinion Summary, Different Types of Opinions, Document Sentiment Classification, Supervised Sentiment Classification, Unsupervised Sentiment Classification, Sentiment Rating Prediction. | **06** |
| **2.** | **Basics of Sentence Subjectivity and Classification**<br>Sentence Subjectivity and Its Significance, Sentence Subjectivity Classification, Basics of Sentence Sentiment Classification, Aspect Sentiment Classification,Rules of Sentiment Composition. | **06** |

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|---|---|---|
| 3. | **Advanced Sentence Subjectivity and Classification**<br>Negation and Its Impact on Sentiment, Aspect and Entity Extraction, Frequency- Based Aspect Extraction, Exploring Syntactic Relations, Using SupervisedLearning for Sentence Classification. | 06 |
| 4. | **Sentiment Lexicon and Comparative Analysis**<br>Sentiment Lexicon Generation, Dictionary-Based Approach, Corpus-Based Approach, Sentiment Word Embedding, Analysis of Comparative Opinions, Identifying Comparative Sentences, Identifying the Preferred Entity Set, Special Types of Comparison. | 06 |
| 5. | **Analysis of Debates and Discussions**<br>Recognizing Stances in Debates, Modeling Debates/Discussions, Modeling Comments, Mining Intents, Problem of Intent Mining, Intent Classification, Fine- Grained Mining of Intent, Detecting Fake or Deceptive Opinions, Different Typesof Spam. | 06 |
| 6. | **Advanced Topics and Quality Assessment**<br>Supervised Fake Review Detection, Automated Discovery of Abnormal Patterns,Model-Based Behavioral Analysis, Group Spam Detection, Quality of Reviews, Quality Prediction as a Regression Problem, Emerging Trends in Sentiment Analysis, Ethical Considerations, Case Studies and Applications. | 06 |

**References-**

**Text Books:**

- Bing Liu, "Sentiment Analysis: Mining Opinions, Sentiments, and Emotions".

**Reference Books:**

- Federico Pozzi, Elisabetta Fersini, EnzaMessina, Bing Liu., "Sentiment Analysis in Social Networks"
- Antonio Moreno, Carlos A. Iglesias, "Sentiment Analysis for social media", MDPI.
- Aakansha Sharaff, G. R. Sinha, Surbhi Bhatia, "New Opportunities for Sentiment Analysis and Information Processing", IGI Global.
- DharmendraSingh Rajput, Ramjeevan Singh Thakur, S. Muzamil Basha, "Sentiment Analysis and Knowledge Discovery in Contemporary Business", IGI Global.

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| Class:- **T. Y. B. Tech.** | Semester: **VI** |
|---|---|
| Course Code: **OE3084** | Course Name: **Materials Management** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
Any engineering project can be completed by consuming resources. Project materials constitute major portion of project cost averagely to the tune of 65% over and above this at the rate of 10-15 % goes in management of these materials. Engineering refers to providing optimized solutions. Research shows that, 1% saved through materials management is equal to 6-10 % increase in sells volume. This course floated as open elective at VI semester of B. Tech would be applicable to all branches, as materials and their management is required by all disciplines. This course will help to find, procure, store, manage and utilize materials in an optimized manner. Students will also be familiar with international purchase, negation and decision making related to materials.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Apply management principles to material management.
2. Develop and apply codification and standardization process.
3. Derive material procurement plan and evaluate vendors.
4. Develop stores layout for optimum stores management.
5. Apply inventory control techniques for material management.
6. Apply M.R.P. logic and systems to material management.

**Prerequisite:** Basic knowledge of the materials as a resource, basic mathematical operators.

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| 1. | **Introduction to Material Management**<br>Importance of materials management, Materials function, Need of Integrated Concept, Scope of material management, Organizations for materials management, span of Control. | 06 |
| 2. | **Codification and Standardization**<br>Standardization and simplification, Aim, Pro's and Con's and scope of Standardization, Classification and levels of standards. Codification, Nature, process, methods and advantages of codification. | 06 |
| 3. | **Purchasing and vendor development**<br>Functions, steps, purchasing cycle. Types of buying, Details of International buying, Procedure, Relevance of Good Supplier Need for Vendor Evaluation-Goals of Vendor Rating-Advantages of Vendor Rating, Negotiation. | 06 |

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|---|---|---|
| 4. | **Warehousing and stores management**<br>Layout of stores and warehouse, material handling in stores, physical control of stocks: obsolete, surplus and scrap management, accounting and record keeping of stores. | 06 |
| 5. | **Inventory Management and Control**<br>ABC analysis- advantages, mechanism, purpose, objectives Importance & Scope of Inventory Control, Types of Inventories, Costs Associated with Inventory, Inventory Control, Selective Inventory Control, Economic Order Quantity, Safety Stocks. | 06 |
| 6. | **Materials Requirement Planning (MRP)**<br>Introduction, objectives, Terminology, Functions served by MRP, MRP Logic, systems and output, Management information form, Lot size consideration, Introduction to Manufacturing resource planning (MRP II). | 06 |

**References:**

**Text Books:**


- Gopalkrishna & Sudarsan, 1. Materials Management, An Integrated approach, 3, PHI.
- Waters, Inventory Control and Management, Wiley.


**Reference Books:**


- C. M. Sadiwala, Ritesh C. Sadiwala, 1. Materials and Financial Management, 2, New Age International Publishers.
- J. R. Tony Arnold, Stephen N. Chapman and Lloyd M. Clive, Introduction to Materials Management, 6, Pearson Publication.
- Materials Management-Procedures, Texts & Cases, A.K. Dutta, Pearson.
- Bailey/Farmer/Crocker/Jessop– Pearson, Procurement Principles & Mgt.
- Inventory Management – Principles and Practices –Narayan/Subramanian– Excel.
- Martand Telsang, Industrial engineering and production management- -S. Chand publication.


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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T. Y. B. Tech.** | Semester: **VI** |
|---|---|
| Course Code: **OE350** | Course Name: **Operations Research** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course is intended to provide students with a knowledge that can make them appreciate the use of various research operations tools in decision making in organizations. Operations Research is the study of scientific approaches to decision-making. Through mathematical modelling, it seeks to design, improve and operate complex systems in the best possible way. The mathematical tools used for the solution of models are either deterministic or stochastic, depending on the nature of the system modelled. In this class, we focus on basic deterministic models and methods in Optimization Techniques.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Identify the necessity and scope of operation research in decision making.
2. Formulate and solve linear programming problems using mathematical models and various optimization techniques.
3. Apply quantitative analysis methods to real-world decision-making scenarios in various industries.
4. Evaluate and improve decision-making processes under uncertainty

**Prerequisite:** Possess basic knowledge of mathematics.

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Introduction**<br>Introduction: Importance of optimization techniques, Applications of Optimization techniques in construction industry, Operations Research models, Phases of OR, Limitations of OR Linear programming. | **06** |
| **2.** | **Linear Programming Problem**<br>Formulation of LPP, Solution by Graphical Method, Simplex Method, Sensitivity analysis. | **06** |
| **3.** | **Transportation Problem**<br>Transportation Problem and its variants- Unbalanced, Maximization, Restrictions on route. | **06** |
| **4.** | **Assignment Problem**<br>Assignment problem and its variants- Non-Square, Maximization, prohibited assignments, Alternate possible solutions. | **06** |

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|---|---|---|
| 5. | **Decision Strategies**<br>Decision strategies – decision making under certainty – decision making under risk – decision making under uncertainty–formulation – decision criterion. | 06 |
| 6. | **Game Theory**<br>Game Theory, Characteristics of game, Game model, Rules for game theory, Mixed Strategies (2×2 games), (2×n). | 06 |

**References:**

**Reference Books:**


- Er. Prem Kumar Gupta, Dr. D. S. Hira, "Operations Research" S. Chand publications.
- Taha, H.A., "Operations Research - An Introduction", Prentice Hall.
- J. K. Sharma, "Quantitative Techniques-for managerial decisions", Macmillan Business books.
- Singiresu S. Rao, "Engineering Optimization", New Age International Publishers.


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| Class: **T. Y. B. Tech** | Semester: **VI** |
|---|---|
| Course Code: **OE358** | Course Name: **Plumbing (Water and Sanitation)** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This subject deals with the Plumbing system and its codes for civil engineering practices. This course is designed to fulfill the requirements of plumbing systems for residential, and industrial building construction. This course will help to select appropriate fixtures, fittings, and treatments based on the user's requirements. A major emphasis in the course is on water plumbing and sanitary fittings.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Explain the scope and purpose of building industry codes and standards
2. Explain different plumbing fixtures and its working.
3. Prepare layout of sanitary drain and storm drain.
4. Calculate water requirement and suggest layout for water supply.
5. Discuss functions of WTP and STP in plumbing system.

**Prerequisite:** Possess basic knowledge of construction activities, Environmental engineering, Building planning and design.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Importance of Codes, Architectural and Structural Coordination**<br>Codes and Standards: Scope, purpose; codes and standards in the building industry, UIPC-I, NBC and other codes, Local Municipal Laws, approvals, general regulations, standards.<br>**Architectural and Structural Coordination**<br>Provisions for plumbing systems, coordination during the planning stage, various agencies involved and their roles, space planning for plumbing systems, plumbing shafts, basements and terraces planning, sunken toilets, location of columns and beams, slabs position, the importance of ledge walls, protection of pipes and structures, waterproofing. | 06 |
| 2. | **Plumbing Terminology**<br>**Plumbing Fixtures**: readily accessible, aerated fittings, flood level rim, floor sink, flushometer valve, flush tanks, lavatories, macerating toilet, plumbing appliances: Traps, Drainage, Valves and Water supply meter. | 06 |

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|---|---|---|
| 3. | **Plumbing Fixtures and Fittings**<br>Introduction to Drainage Fixture Units (DFU): pipes, water closets, bidets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dishwasher, mop sink, overflows, strainers, prohibited fixtures, floor drains, floor slopes, hot water temperature controls, installation standard dimensions in plan and elevation, introduction to vent size and vent requirement, the purpose of venting, vent connections, vent stacks, cleanouts, venting of interceptors, | 06 |
| 4. | **Sanitary Drainage and Storm Drain**<br>One pipe and Two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workmanship, prohibited fittings and practices, T and Y fittings, cleanouts, pipe grading, fixtures below invert level, sizing case study as per NBC, safety, | 05 |
| 5. | **Water Supply, Grey and Reclaimed Water**<br>Sources of water, potable and non-potable water, reclaimed water, calculating daily water requirement and storage, hot and cold water distribution system, backflow prevention, air gap, cross connection control, controls and thermal expansion fixtures its installation and testing, protection of underground pipes, introduction to Water Supply Fixture Units (WSFU) and sizing. | 05 |
| 6. | **Introduction to WTP and STP**<br>Need to reduce and reuse, 24x7 water supply, metering and sub-metering, typical daily water and wastewater calculations for a project. Sources, utility and treatment of water, parameters of water quality, parts of water treatment plant (WTP), disinfection methods, storage conditions, RO water systems, rainwater harvesting treatment, desalination. Grey water and black water, characteristics of domestic sewage, sewage treatment methods, aerobic and anaerobic treatment, level of treatment, reclaimed water. | 08 |

**References:**

**Codes of Practice:**

- Bureau of Indian Standards IS 17650 Part 1 and Part 2 for Water Efficient Plumbing Products, BIS, New Delhi.
- National Building Code (NBC) of India.
- Uniform Illustrated Plumbing Code-India (UIPC-I) An IPA and IAPMO (India) Publication.
- Water Efficient Products-India (WEP-I), An IPA and IAPMO (India) Publication.
- Water Efficiency and Sanitation Standard (WE. Stand) An IPA and IAPMO (India) Publication.

**Reference Books:**

- Berry, "Water Pollution", CBS Publishers.

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- An IPA and IAPMO (India), "A Guide to Good Plumbing Practices", An IPA and IAPMO (India) Publication.
- O.P. Gupta, "Elements of Water Pollution Control Engineering", Khanna Book Publishing, New Delhi.


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| Class:- **T.Y. B. Tech.** | Semester- **VI** |
|---|---|
| Course Code: **OE372** | Course Name: **Industrial Safety** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | – | 3 |

**Course Description:**
This course provides a comprehensive understanding of industrial safety, focusing on electrical hazards, fire risks, machine safety, and plant design with emphasis on prevention and control measures Students gain knowledge of occupational health, ergonomics, safety psychology, and stress management for promoting workplace well-being. The course also introduces accident prevention principles, hazard identification techniques, and risk analysis tools Overall, it builds strong awareness of safety management systems, statutory provisions, and environmental protection in industrial settings.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Analyze electrical and fire hazards by examining safe operating limits.
2. Evaluate the suitability of machine guards, hazardous-area electrical equipment, and high-pressure system.
3. Evaluate plant layout, ventilation, thermal comfort, and industrial lighting systems with reference to National Building Code.
4. Design safety and health management strategies incorporating ergonomics, occupational health, stress management.
5. Analyze accident causation using hazard identification tools and evaluate preventive measures through plant safety inspection.

**Prerequisite:** Basic Electrical Engineering, Workshop Practice / Manufacturing Processes and Environmental Studies / Industrial Engineering.

**Course Content**

| Unit No | Description | Hrs. |
|---|---|---|
| 1. | **Electrical Hazards**<br>Safe limits of amperages, voltages, distance from lines, etc., Joints and connections, Overload and Short circuit protection, Earthing standards and earth fault protection, Protection against voltage fluctuations, Effects of shock on human body Hazards from Borrowed neutrals, Electrical equipment in hazardous atmosphere, Criteria in their selection, installation, maintenance and use, Control of hazards due to static electricity. Energy Conservation & Safety | 06 |
| 2. | **Fire and other Hazards**<br>General causes and classification of fire, Detection of fire, extinguishing methods, firefighting installations with and without water. ii. Machine | 06 |

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| | guards and its types, automation. High pressure hazards, safety, emptying, inspecting, repairing, hydraulic and nondestructive testing, hazards and control in mines. | |
| 3. | **Plant design and Housekeeping**<br>Plant layout, design and safe distance, Ventilation and heat stress, Significance of ventilation, Natural ventilation, Mechanical ventilation Air conditioning ii. National Building code part VIII and Building service, Thermal comfort, Indices of heat stress, Physiology of heat regulation. Statutory provisions. | **06** |
| 4. | **Industrial Lighting**<br>Purpose of lighting, Uses of good illumination, recommended optimum standards of illumination, Design of lighting installation, Standards for lighting and color. Testing and Maintenance of ventilation systems. | **06** |
| 5. | **Safety and Health Management**<br>Occupational Health Hazards, Promoting Safety, Safety and Health training, Stress and Safety. Safety Psychology, Safety information system, Ergonomics - Introduction, Definition, Objectives, Advantages. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders., Importance of Industrial safety. Safety of Environment | **06** |
| 6. | **Principles of accidents prevention**<br>Definition: Incident, accident, injury, dangerous occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes, etc. Accident Prevention: Theories / Models of accident occurrences, Principles of accident prevention, Accident and Financial implications, Hazard identification and analysis: fault tree analysis, Event tree analysis, failure modes and effects analysis, Hazop studies, Job safety analysis – examples, Plant safety inspection - objectives and types check procedure inspection report. | **06** |

**References –**

**Text Books:**

- The Factories Act with amendments 1987, Govt. of India Publications DGFASLI, Mumbai
- Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi.

**Reference Books:**

- Industrial Safety - National Safety Council of India ISHET.
- Dr. K. U. Mistry - Fundamentals of Industrial Safety & Health, Siddharth Prakashan, Ahmadabad.

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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech.** | Semester-VI |
|---|---|
| Course Code: **OE342** | Course Name: **Data Mining** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
The course helps to learn concepts, techniques and tools they need to deal with various facets of data mining process, including data collection and its preprocessing. The orientation of course is to understand the data mining concepts. The course helps to learn Data mining techniques and algorithms. It assists in comprehending the data mining environments inline to supervised and unsupervised learning patterns. The organization of web data inline to structured/unstructured will be examined. Moreover, a holistic view data mining applications will be surveyed.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Compare various conceptions of data mining as evidenced in both research and application.
2. Apply Classification and Clustering techniques for real time problems.
3. Characterize the various kinds of patterns that can be discovered by association rule mining.
4. Analyze web mining techniques for structured/un-structured data patterns.
5. Evaluate mathematical methods underlying the effective application of data mining.

**Prerequisite:** Basic Mathematics, Descriptive statistical techniques.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Data Mining Tasks, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining, Data Pre-processing: Why Preprocessing, Cleaning, Integration, Transformation, Reduction, Discretization. | 06 |
| 2. | **Classification**<br>Decision Trees, Bayesian Classification, Rule-Based Classification, Neural Network-Based Algorithms, Support Vector Machines, Classification by Association Rule Analysis, Nearest Neighbor Classifier. | 06 |
| 3. | **Clustering**<br>Classification of clustering algorithms, Hierarchical Algorithms, Agglomerative Algorithms, Divisive Clustering, K-Means Clustering, Clustering Large Databases. | 06 |

| | | |
|---|---|---|
| 4. | **Association Rules**<br>What is an Association Rule?, Methods to Discover Association Rules, A Priori Algorithm, Partition Algorithm, FP-Tree Growth Algorithm, Generalized Association Rule. | 06 |
| 5. | **Web Mining**<br>Web Mining, Web Content Mining, Web Structure Mining, Web Usage Mining, Text Mining, Unstructured Text, Text Clustering. | 06 |
| 6. | **Applications**<br>Applications and Trends in Data Mining, Data Mining Applications, Social Impacts of Data Mining, Trends in Data Mining. | 06 |

**References -**

**Text Books:**


- Margaret H. Dunham," Data Mining Introductory and Advanced Topics", Prentice Hall.
- Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems.


**Reference Books:**


- Arun K Pujari, Data Mining Techniques, University Press.
- P. Tan, M. Steinbach and V. Kumar, "Introduction to Data Mining", Addison Wesley.


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| Class:- **T. Y. B. Tech** | Semester-**VI** |
|---|---|
| Course Code: **OE368** | Course Name: **AI for Agriculture** |

| **L** | **T** | **P** | **Credits** |
|---|---|---|---|
| **3** | **--** | **--** | **3** |

**Course Description:**
The course introduces students to the intersection of Artificial Intelligence (AI) and agriculture. It focuses on applying AI techniques such as data analysis, computer vision, NLP, and generative AI to solve real-world agricultural problems. Students will explore ethical concerns, sustainable development goals (SDGs), and AI project development. The course includes case studies and practical use cases to enhance experiential learning.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Specify AI fundamentals, domains, and ethical aspects in agriculture.
2. Identify agricultural problems and apply data acquisition techniques.
3. Develop and evaluate AI models for agricultural applications.
4. Use statistical and generative AI methods for agri-analysis.
5. Analyze AI policies, ethical issues, and future agri-trends.

**Prerequisite:** Basic Statistics and Probability, Fundamentals of Artificial Intelligence and Python Programming.

**Course Content**

| **Unit No.** | **Description** | **Hrs** |
|---|---|---|
| **1.** | **Introduction to AI in Agriculture**<br>Role of AI in agriculture, types and domains of AI, relevance to SDGs, overview of AI Project Cycle, introduction to AI Ethics. | **06** |
| **2.** | **Problem Scoping and Data Acquisition**<br>Problem scoping in agriculture, challenges in Agri-domain, data types, sources, data acquisition, data handling and visualization, AIoT. | **06** |
| **3.** | **AI Modeling and Deployment**<br>Introduction to modeling, training and testing datasets, model evaluation metrics, deployment, practical examples of AI models in Agri-apps. | **06** |
| **4.** | **Statistical AI Techniques in Agriculture**<br>Statistical data analysis, regression and classification techniques, crop yield and damage prediction, introduction to generative AI for data. | **06** |

| | | |
|---|---|---|
| **5.** | **AI Applications: CV and NLP in Agriculture**<br>CV techniques and use cases (e.g., crop/rice/livestock), NLP applications (chatbots, market intelligence), ethical implications, generative AI in CV/NLP. | **06** |
| **6.** | **Policy, Ethics, and Future Trends in AI for Agriculture**<br>Ethical considerations in deploying AI solutions in agriculture, privacy and data protection issues, AI policy frameworks, government initiatives, global and national regulations, future trends and opportunities in AI-driven agriculture. | **06** |

**References -**

**Text Books:**


- Abhishek Ghosh & Manju Khari, "Artificial Intelligence for Agriculture", CRC Press.
- Melanie Mitchell, "Artificial Intelligence: A Guide for Thinking Humans", Penguin.
- J. Zhou, J. Guo, "Artificial Intelligence in Precision Agriculture", Springer.


**Reference Books:**


- Rohit Sharma, "AI and IoT for Sustainable Development in Agriculture", Springer.
- Niall Adams, "Data Science for Agriculture and Environmental Research", CRC Press.
- Rajalingappaa Shanmugamani, 'Deep Learning for Computer Vision", Packt Publishing.


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| Class: - **T.Y. B. Tech** | Semester- **VI** |
|---|---|
| Course Code: **OE3401** | Course Name: **Cyber Security (Open Elective)** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
Cybersecurity is the practice of protecting systems from cyber-attacks. It is important because effective cybersecurity reduces the risks of cyber-attacks. Cybersecurity is a high-demand but changing field. Since hackers are trying to find new ways to access, change, or delete sensitive information and extort money, users must be aware of cyber threats and comply with basic cybersecurity principles. This course will help in understanding cybercrimes, their laws & and various techniques for investigating different cybercrimes. This course also focuses on advanced issues in e-banking and financial crimes

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Describe fundamental terms in cybercrime legislation.
2. Compare various cyber-attacks & offences.
3. Analyze the Indian IT Act 2000 & amendments in the IT Act.
4. Asses social networks and security issues related to social media platforms.
5. Apply a strategy for creating awareness about cyber security for e-banking and legal issues among the social community.
6. Devise the best practices and policies in various layers of cyberspace.

**Prerequisite:** Basic Computer Technology.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Cybersecurity**<br>Defining Cyberspace and Overview of Computer and Technology, Architecture of cyberspace, Communication and web technology, Internet, World Wide Web, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security. | 06 |
| 2. | **Cyber Crime and Cyber Law**<br>Classification of cybercrimes, Common cybercrimes - cybercrime targeting computers and mobiles, cybercrime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, viruses and worms, Cybercriminal's modus-operandi, Reporting of cybercrimes, Remedial and mitigation measures, Legal perspective of cybercrime. | 07 |

| | | |
|---|---|---|
| 3. | **The Indian IT Act**<br>Cybercrime and Legal landscape around the world, cyber laws, challenges faced in designing cyber laws, IT Act: Cyber Crime (Section 65-74), Amendments to the Indian IT Act 2000. | 05 |
| 4. | **Social Media Overview and Security**<br>Introduction to Social Networks. Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, social media marketing, social media privacy, Challenges, opportunities and pitfalls in online social networks, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, best practices for the use of social media, Case studies. | 06 |
| 5. | **E-Commerce and Digital Payments**<br>Definition of E-Commerce, Main components of E-Commerce, Elements of E-Commerce Security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stakeholders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), RBI guidelines on digital payments and customer protection in unauthorized banking transactions. Relevant provisions of Payment Settlement Act,2007. | 06 |
| 6. | **Digital Devices Security, Tools and Technologies for Cyber Security**<br>End Point device and mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions. | 06 |

**References -**

**Text Books:**

- Sumit Belapure and Nina Godbole, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd.
- Henry A. Oliver, "Security in the Digital Age: Social Media Security Threats and Vulnerabilities ", Create Space Independent Publishing Platform, Pearson.

**Reference Books:**

- James Graham, Ryan Olson, "Cyber Security Essentials", Rick Howard CRC Press, Taylor & Francis Group.
- Cyber Crime Impact in the New Millennium, by R. C Mishra, Auther Press.
- Kumar K, "Cyber Laws: Intellectual Property & E-Commerce Security" Dominant Publishers.

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| Class:- **T.Y. B. Tech** | Semester-VI |
|---|---|
| Course Code: **OE364** | Course Name: **AI for Manufacturing** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
This course introduces the applications of Artificial Intelligence in the manufacturing sector. It explores AI Industry use cases and techniques like quality monitoring, predictive maintenance, and demand forecasting. The course also discusses AI's ethical concerns, AI project cycle and its usability in manufacturing applications.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Describe Artificial Intelligence and its potential impact in manufacturing.
2. Apply AI techniques to solve problems in the manufacturing sector.
3. Demonstrate the use of AI techniques for robotic perception, environment understanding, and intelligent decision-making.
4. Illustrate key AI techniques used for fault detection and prediction in mechanical and industrial systems.
5. Explain the principles and techniques of demand forecasting in the context of manufacturing operations.
6. Examine ethical concerns of AI to create Responsible AI.

**Prerequisite:** Basics of Manufacturing, Python Programming.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to AI for Manufacturing**<br>Domains of AI, How can AI contribute to Manufacturing, Different AI opportunities in the manufacturing sector, popular use cases in the manufacturing, AI project life cycle and its use in manufacturing sector. | 06 |
| 2. | **AI Modeling and Evaluation**<br>Data acquisition, Data analysis and Preprocessing, Model Training, Evaluation, and deployment, Platforms for AI project deployment. | 05 |
| 3. | **Computer Vision and Robotics Process Automation**<br>Basic of computer vision, Use of computer vision in manufacturing process, AI for robot perception and decision-making, AI-driven robots and cobots, Path planning and motion control using ML, Human-robot collaboration, Real-world applications: welding, assembly, pick-and-place. | 07 |
| 4. | **Predictive Maintenance** | 06 |

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|---|---|---|
| | Predictive maintenance in manufacturing, AI techniques for fault prediction in mechanical systems, Use cases of AI in equipment maintenance, Vibration analysis and failure prediction. | |
| 5. | **Inferencing on Edge and Demand Forecasting**<br>Edge inferencing, edge inferencing in manufacturing, demand forecasting, solving problem in manufacturing using demand forecasting. | 06 |
| 6. | **AI Ethics and Responsible AI**<br>AI Ethics, Importance of AI Ethics in manufacturing, Responsible AI, frameworks for developing responsible AI. | 06 |

**References -**

**Text Books:**

- Masoud Soroush, Richard D Braatz, "Artificial Intelligence in Manufacturing: Concepts and Methods", Academic Press, Paperback ISBN: 9780323991346
- Andrew Ng, "Machine Learning Yearning", https://info.deeplearning.ai/machine-learning-yearning-book.
- Xiaofei Wang, Yiwen Han, Victor C. M. Leung, Dusit Niyato, Xueqiang Yan, Xu Chen, "Edge AI: Convergence of Edge Computing and Artificial Intelligence", Springer Singapore.
- Vincent C. Muller, "Ethics of Artificial Intelligence and Robotics", Metaphysics Research Lab, Stanford University.

**Reference Books:**

- George Chryssolouris, Kosmas Alexopoulos, Zoi Arkouli, "A Perspective on Artificial Intelligence in Manufacturing", Springer, Kindle Edition.
- Kim Phuc Tran, "Artificial Intelligence for Smart Manufacturing: Methods, Applications, and Challenges", Springer International Publishing AG.

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| Class:- **T.Y. B.Tech** | Semester-**VI** |
|---|---|
| Course Code: **OE348** | Course Name: **Information Technology Foundation Program** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course introduces students to fundamental problem-solving methods, algorithms, and flowcharting techniques used in computing. It covers C programming and basic data structures to develop efficient solutions for computational problems. The course also explores programming paradigms, coding standards, and debugging practices for writing structured and optimized programs. Students learn core object-oriented concepts along with relational data management through ER modeling, normalization, and SQL queries. Additionally, the course provides an overview of essential project management principles, including planning, estimation, scheduling, and risk management.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Explain fundamental problem-solving methods using logic, algorithms, and flowcharts to represent solutions systematically.
2. Develop C programs using control structures, arrays, strings, functions, and basic data structures to solve computational problems.
3. Analyze different programming paradigms, coding standards, optimization techniques, and debugging methods to improve program structure and efficiency.
4. Apply object-oriented principles such as abstraction, encapsulation, relationships, polymorphism, interfaces, and packages in program design.
5. Evaluate relational data models using ER diagrams, normalization techniques, and SQL queries to design efficient database systems.
6. Create effective project plans by integrating estimation, scheduling, risk management, communication strategies, and monitoring tools.

**Prerequisite:** Basic understanding of computer fundamentals and logical reasoning.

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| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| 1. | **Problem Solving Techniques**<br>Introduction to Logic, Introduction to Problem Solving, Introduction to Algorithms, Introduction to Algorithms to Flowcharts. | 06 |
| 2. | **Introduction to C and Data Structures**<br>Computer Terms and Concepts, Introduction to C, Introduction to basic data structures, Selection Control Structure, Iteration Control Structure, Demonstration of 1D and 2D arrays, Function, String, Searching and Sorting Algorithms. | 06 |
| 3. | **Programming Paradigms**<br>Programming Paradigm, Basic Programming, Coding Standards, Best Practices, Introduction to code optimization, Modular approaches through Functions, Testing and Debugging. | 06 |
| 4. | **Object Oriented Concepts**<br>Introduction to Object Oriented Programming, Abstraction and Encapsulation, Relationships, Polymorphism, Interfaces and Packages. | 06 |
| 5. | **Relation Data Management**<br>Introduction, ER modelling, Normalization, SQL Queries. | 06 |
| 6. | **Project Management**<br>Project Management Concepts, Project Management Activities, Project Estimation, Project Planning and Scheduling, Project Risk Management, Project Execution and Monitoring, Project Communication Management, Project Management Tools, Project Monitoring and Tools. | 06 |

**References –**

**Text Books:**


- Yashavant Kanetkar, Let Us C, BPB Publications.
- E. Balagurusamy, Programming in ANSI C, McGraw-Hill Education.


**Reference Books:**


- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press.
- Reema Thareja, Data Structures Using C, Oxford University Press.


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| Class:- **T.Y. B. Tech.** | Semester- **VI** |
|---|---|
| Course Code: **OE366** | Course Name: **AI for Cybersecurity** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
This course introduces students to the fundamentals of AI in cybersecurity, exploring how AI can both enhance security and introduce new risks. Learners will study secure AI system development, data protection, and sector-specific challenges, while examining real-world applications and current best practices. By the end, students will be prepared to assess and implement AI-driven cybersecurity solutions.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Identify the Role of AI in Cybersecurity.
2. Analyze and Assess Security Risks in AI Systems.
3. Apply Security Best Practices to AI Development and Deployment.
4. Evaluate Sector-Specific AI Cybersecurity Challenges.

**Prerequisites**: Basic knowledge of networks, scheduling, and cybersecurity concepts

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction to AI and Cybersecurity**<br>Overview of cybersecurity: definitions, objectives, and challenges, Evolution of AI in cybersecurity, Key cybersecurity threats and vulnerabilities, Role of AI in modern cyber defense,Ethical, legal, and policy considerations. | 06 |
| 2. | **Cybersecurity Foundations for AI Systems**<br>ICT infrastructure and AI hosting environments, Security management of ICT infrastructure, Cybersecurity certification and compliance, Cybersecurity legislation and policies relevant to AI, Basic security principles and procedures, Risk management and conformity assessment. | 06 |
| 3. | **AI Fundamentals and Security Implications**<br>Types of AI and their applications in cybersecurity, AI system life cycle: development, deployment, operation, and maintenance, Key assets: data, models, artefacts, actors, processes, environments, Threats specific to AI: transparency, interpretability, bias, accountability, Robustness, resilience, and fairness in AI systems, Security controls for AI components. | 06 |

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|---|---|---|
| 4. | **Data Security in AI Systems**<br>Importance of data security in AI, Data supply chain risks and mitigation, Data poisoning and integrity attacks, Data drift and its impact on AI outcomes, Best practices: encryption, digital signatures, provenance tracking, Secure storage and trust infrastructure | 06 |
| 5. | **AI-Specific Cybersecurity Practices**<br>Secure AI model development and deployment, Adversarial attacks and defenses, AI model explainability and auditability, Monitoring and incident response for AI systems, Security testing and validation for AI, Regulatory frameworks and guidelines for AI security. | 06 |
| 6. | **Advanced Topics in AI Cybersecurity**<br>Sectoral cybersecurity practices for AI (health, energy, telecom), High-risk AI systems and compliance with regulations, Emerging threats and future trends in AI cybersecurity, international standards and best practices, Case studies: AI-driven attacks and defenses, Survey analysis and conclusions from industry reports. | 06 |

**References –**

**Text Books:**


- Alessandro Parisi, Hands-On Artificial Intelligence for Cybersecurity, Packt Publishing.
- Mark Stamp, Introduction to Machine Learning for Security Professionals, Wiley.


**Reference Books:**


- Ishaani Priyadarshini, Rohit Sharma, Artificial Intelligence and Cybersecurity: Advances and Innovations, Routledge.


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| Class:-**T.Y. B. Tech** | Semester-**VI** |
|---|---|
| Course Code: **OE3284** | Course Name: **Supply Chain Management** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
In a typical supply chain, raw materials are procured and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain. In this course, students will able to present and explain concepts, insights, practical tools, and decision support systems important for the effective management of the supply chain. This course will help the students to develop an understanding of the following key areas and their interrelationships:

- The strategic role of a supply chain
- The key strategic drivers of supply chain performance
- Supply chain network design and analytical methodologies for supply chain analysis

This course will help the students to learn the strategic importance of good supply chain design, planning, and operation for every firm. The students will be able to understand how good supply chain management can be a competitive advantage, whereas weaknesses in the supply chain can hurt the performance of a firm.

**Course Learning Outcomes:**
After successful completion of the course, the students will be able to,

1. Identify the role and key issues in the supply chain management.
2. Select appropriate SC strategies under given situations.
3. Design the inventory system and level at various locations in supply chain.
4. Specify the distribution and transportation requirements.
5. Develop appropriate strategic alliances for enhancing the performance of SC
6. Describe different strategies used to mitigate risk in global supply chain.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Understanding of Supply Chain**<br>Objectives of a supply chains, decision phases, stages of supply chain, supply chain process view, cycle view of supply chain process, push/pull view of supply chain processes, key issues in SCM. | 06 |
| 2. | **Supply chain drivers and obstacles**<br>Four drivers of supply chain- inventory, transportation, facilities and information; A framework for structuring drivers in supply chain, supply | 06 |

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| | chain strategies, strategic fit, Obstacles to achieve strategic fit, value of information, Bullwhip effect and reduction. | |
| 3. | **Role of Inventory Management in supply chain**<br>Role of forecasting, characteristics of forecast, Components of forecast, Basic approach to demand forecasting, Role of cycle inventory, Economics of scale to exploit fixed costs and discounts, cycle time related costs, Safety inventory, single stage inventory model, risk pooling, centralized and decentralized systems of planning inventory in supply chain | 06 |
| 4. | **Network Planning and supply chain Integration**<br>Network design, warehouse location, service level requirements, integrating inventory positioning and network design, supply chain integration. Push-pull and pull-push type systems, demand driven strategies, Impact of internet on supply chain strategies, Transportation in a supply chain, facilities affecting transportation decision, modes of transportation and their performance characteristics. | 06 |
| 5. | **Distribution strategies and strategic alliances**<br>Introduction, Centralized vs. decentralized control, direct shipment, cross docking, push based vs. pull based supply chain, third party logistics (3PL), Retailer-Supplier relationship issues, requirements, success and failures, distributor integration types and issues, role of pricing and revenue management in supply chain. Role of sourcing in supply chain, supplier scoring and assessment. | 06 |
| 6. | **Global logistics and Risk management**<br>Agile supply chains, Introduction to global SCM, risk management, issues in international SCM, regional differences in logistics, design for logistics, supplier integration in to new product development, pricing issues and smart pricing. IT and Business processes in supply chain. | 06 |

**References -**

**Text books:**

- Supply Chain Management: Strategy, Planning, and Operation, Sunil Chopra and Peter Meindel, Prentice Hall.

**Reference Books:**

- Logistics and Supply Chain Management,Christopher martin, Pearson Education Asia.
- Marketing logistics: A supply chain Approach, Kapoor KK; KansalPurva, Pearson Education Asia.
- Designing And Managing Supply Chain Concepts, Strategies and Case Studies, David Simchi-Levi, Ravi Shankar; McGraw Hill Publication.

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| Class:-**T.Y. B. Tech** | Semester-**VI** |
|---|---|
| Course Code: **OE3324** | Course Name: **Entrepreneurship Development** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
Now a day's all engineers run behind campus interviews and secured job. Very few of them think seriously about their career as entrepreneur. Instead becoming job seekers, they should become job creators. Nation also expects same thing from young technocrats. Therefore, startup India&Make in India mission are in progress. Technopreneurers should take advantage of these mission to start their career as Entrepreneur.
Up till now belief was Entrepreneurs are born and cannot be created. But research by David Mc Leland& Entrepreneurship Development Institute of India, Ahmedabad, has proved that with proper guidance & training successful entrepreneurs can be created. With reference to guide lines provided by EDI Ahmedabad, NIESBUD, NIMSME, syllabus for course is designed

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Identify, analyze & select business opportunity to suit his personality based on SWOT analysis.
2. Make market research & survey for selected business.
3. Prepare and apprise detailed Project Report.
4. Formulate plan for financial management of project.
5. Apply managerial inputs for starting & establishing his own business.

**Prerequisite:** Student from any branch of engineering with strong passion for Entrepreneurship.

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Entrepreneurial motivation**<br>Entrepreneur-Definition, Concept, importance, nature, types, entrepreneurial culture, growth, entrepreneurial traits & motivations.<br>**Entrepreneurship:**<br>Aspects, Barrier to entrepreneurship, Entrepreneur competencies, Industrial Economics. | **06** |
| **2.** | **Project identification** | **06** |

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|---|---|---|
| | Concept of Project & classification, searching for business idea, opportunity finding, Scanning Business Idea & development. Selection of Product/ Service, core competence, product life cycle, new product development process, creativity and innovation in product modification/development.<br>**Process selection:** Technology life cycle, forms and cost of transformation, factors affecting process selection.<br>Factors affecting selection of location for an industry. Importance of material handling and its relevance with facility location.<br>Calculate capacity of plant and its relation with economies of scale. Including flexibility | |
| **3.** | **Design Thinking**<br>Steps in design thinking, application, case study<br>**Business Canvas:** Importance, construction and application with case study<br>**Marketing:** Market survey, 4 P of marketing, USP, Branding.<br>**JBTD**: Jobs to be done | **08** |
| **4.** | **Setting Up of Enterprise**<br>Steps for starting small scale industry, whom to approach for what, incentives and subsidies, Role of state development, finance corporations, nodal agencies, Role of consultancy Organization, Lead Bank, various clearances & certificate required for a particular industry, Start Up India & Make in India program. Factory design and Layout | **04** |
| **5.** | **Costing and Accounting**<br>Financial appraisal, Direct and Indirect costs, Financial projections, Balance Sheet, Profit and loss account, Income tax, GST, Excise Tax, Long term loan, short term loan, over drafts, letter of credit, working capital management. | **04** |
| **6.** | **Project Report**<br>Project Report preparation, Preliminary Project Report, feasibility report, marketing research, Project appraisal, statement of cash flow, accounting ratios, Break-even analysis | **08** |

**References: -**

**Text Books:**


- Dynamics of Entrepreneurial Development and Management - By Vasant Desai, Himalaya Publishing House,
- Management of small scale Industries, - By Vasant Desai; Himalaya Publishing House, Delhi
- Small Scale Industries and Entrepreneurship, - By Vasant Desai, Himalaya Publishing House, Delhi.


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**Reference Books:**


- Entrepreneurship Development and Management -By Neeta Bopodikar, Himalaya Publishing House, Delhi.
- Project Profiles for S.S.I. Mechanical Products.
- E.D.P. Study Material by by Dr. Dinesh Awasthi, Mr. Raman Jossi V Padmananal E.D.I Ahamadabad.
- E.D.P. Study Material by MITCON Pune.
- E.A.P. Study Material by Mr. Raman Gujaral E.D.I. Ahmadnagar.

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B.Tech.** | Semester-**VI** |
|---|---|
| Course Code: **OE3024** | Course Name: **Reliability Engineering** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
The concepts of Reliability Engineering are applicable to almost every engineering system to ensure that reliable products are designed and manufactured. Therefore, this course is introduced as an Open Elective for Third Year students. This course aims at making the students capable of analyzing the reliability of engineering systems and ensure that they study the techniques to determine and improve the reliability of different engineering systems. The course introduces fundamental concepts of reliability engineering, techniques to calculate the reliability of different types of systems, methods to improve the reliability, system reliability modelling, reliability analysis methods, reliability testing and software reliability.

**Course Outcomes:**
After successful completion of the course, students will be able to-
1. Explain the fundamental concepts and applications of Reliability Engineering.
2. Determine the reliability of simple and complex systems.
3. Apply different reliability allocation techniques for reliability analysis.
4. Apply the principles and techniques for reliability design and improvement.
5. Apply different techniques for reliability analysis of engineering systems.
6. Explain the methods of testing for hardware and software reliability

**Prerequisite:** Engineering Mathematics

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Reliability Engineering**<br>Reliability Engineering and Applications, failures and failure modes, reliability function, MTTF, MTBF, MTTR, repairable and non-repairable items, reliability economics, safety and reliability, quality and reliability, cost and system effectiveness, life characteristic phases, IoT in reliability analysis. | 06 |
| 2. | **System Reliability Modeling**<br>Discrete probability distribution, Continuous Probability Distributions, Reliability Block Diagram, Hazard rate and failure density, constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, Series system, Parallel system, Series-Parallel system, Complex system, k-out-of-m systems. | 06 |

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|---|---|---|
| 3. | **Reliability Allocation**<br>Definition, reliability allocation techniques, equal apportionment, AGREE method, ARINC method, feasibility of objectives apportionment technique, minimum effort method. | 06 |
| 4. | **Design for Reliability**<br>Reliability design process, reliability considerations in design, stress-strength interaction, factor of safety, margin of safety, loading roughness, redundancy, reliability improvement techniques, types of redundancy, Markov models, single unit, two unit and three-unit Markov models. | 06 |
| 5. | **Techniques for Reliability Analysis**<br>Failure modes, effects and criticality analysis (FMECA), fault tree analysis, minimal cut set method, minimal tie set method, Ishikawa diagram, case study. | 06 |
| 6. | **Reliability Testing**<br>Introduction to reliability testing, Accelerated Life Testing and Highly Accelerated Life Testing (HALT), Highly Accelerated stress Screening (HASS), software reliability: fundamental concepts, comparison and prevention, software testing. | 06 |

**References –**

**Text Books:**


- L. S. Srinath, Reliability Engineering, East-West Press.
- Elsayed A. Elsayed, Reliability Engineering, Addison Wesley.
- Kailash C. Kapur, Reliability Engineering.


**Reference Books:**


- Ebeling C.E., Introduction to Reliability and Maintainability Engineering", Overseas Press. Pvt Ltd.
- B.S.Dhillon, Maintainability, Maintenance and Reliability for Engineers, CRC Press.
- L.S.Srinath, Reliability Engineering, EWP.
- Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Springer,.
- Roger D Leitch, Reliability Analysis for Engineers: An Introduction, Oxford University Press.
- S S. Rao, Reliability Based Design, Mc Graw Hill Inc.
- E.E.Lewis, Introduction to Reliability Engineering, John Wiley and Sons.
- Basu S.K, Bhaduri, Terotechnology and Reliability Engineering, Asian Books Publication.
- Dr. A. K. Gupta, Reliability, Maintenance and Safety Engineering.
- John D. Musa, Software Reliability Engineering, Tata McGraw Hill.

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| Class:- **T.Y. B.Tech.** | Semester-**VI** |
|---|---|
| Course Code: **OE362** | Course Name: **Flexible Manufacturing System** |

| L | T | P | Credits |
|---|---|---|---|
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**Course Description:**
A flexible manufacturing system (FMS) gives manufacturing firms an advantage to quickly change a manufacturing environment to improve process efficiency and thus lower production cost. However, upfront costs may be greater for installing specialized equipment that allows for flexibility and customization. This course imparts knowledge of FMS evolution, objectives, applications and focuses on FMS layout, processing stations material handling systems etc.

**Course Outcomes:**
After successful completion of the course, students will be able to-
1. Apply the concepts to the development of FMS.
2. Discuss the control structure used in manufacturing systems.
3. Discuss the Scheduling & Loading of FMS.
4. Identify hardware and software components of FMS.
5. Summarize the concepts of Cellular Manufacturing.
6. Summarize the concepts of Additive Manufacturing.

**Prerequisite:** Nil

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>Flexible and rigid manufacturing, F.M. Cell and F.M. System concept, Types and components of FMS, Tests of flexibility, Group Technology and FMS, unmanned factories, Economic and Social aspects of FMS. Advantages and disadvantages of FMS Group technology. | 06 |
| 2. | **Control structure of FMS**<br>Architecture of typical FMS, Automated work piece flow, Control system architecture – Factory level, Cell level; hierarchical control system for FMS, LANs - characteristics, transmission medium, signalling, network topology and access control methods. | 06 |
| 3. | **Scheduling & Loading of FMS**<br>Introduction, Scheduling of operations on a single machine, 2 machine flow shop scheduling, 2 machine job shop scheduling, scheduling 'n' operations on 'n' machines, Scheduling rules, loading problems, Tool management of FMS, material Handling system schedule. Problems. | 06 |

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| 4. | **FMS hardware and software**<br>FMS computer hardware and software, general structure and requirements, PLCs, FMS installation and implementation, acceptance testing Characteristics of JIT pull method, small lot sizes, work station loads, flexible work force, line flow strategy. supply chain management. | 06 |
| 5. | **Cellular Manufacturing**<br>Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing. Various case studies of implementation of FMS at industries. | 06 |
| 6. | **Additive Manufacturing**<br>Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes-Benefits- Applications. | 06 |

**References –**

**Text Books:**


- Shivanand H.K., Benal MM, Koti V, "Flexible Manufacturing System", New age international (P) Limited, New Delhi.
- Mikell P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", PHI.


**Reference Books:**


- Kalpakjin, "Manufacturing Engineering and Technology ", AddisonWesley Publishing Co.
- Viswanadhan, N. & Narahari, Y., "Performance Modelling of Automated Manufacturing Systems", PHI.
- Pinedo, Michael & Chao, Xiuly, "Operations Scheduling with Applications in Manufacturing & Services", McGraw Hill International Editions (with 2 Floppy Disks of LEKIN Scheduling Software).
- Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer.


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| Class: - **Third Year B. Tech** | Semester-VI |
|---|---|
| Course Code: **OE344** | Course Name: **Supply Chain Analytics** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | -- | 3 |

**Course Description:**
In a typical supply chain, raw materials are procured, and items are produced at one or more factories, shipped to warehouses for intermediate storage, and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must consider the interactions at the various levels in the supply chain. In this course, students will be able to present and explain concepts, insights, practical tools, and decision support systems important for the effective management of the supply chain. This course will help the students to develop an understanding of the following key areas and their interrelationships:

- The strategic role of a supply chain
- The key strategic drivers of supply chain performance
- Supply chain network design and analytical methodologies for supply chain analysis

This course will help the students to learn the strategic importance of good supply chain design, planning, and operation for every firm. The students will be able to understand how good supply chain management a competitive advantage can be, whereas weaknesses in the supply chain can hurt the performance of a firm.

**Course Learning Outcomes:**
After successful completion of the course, the students will be able to,

1. Identify the role and key issues in the supply chain management.
2. Explain the important supply chain drivers and their significance in strategic planning.
3. Estimate the demand using suitable demand forecasting method.
4. Design the inventory system and level at various locations in supply chain.
5. Design the supply chain network using appropriate network design methodology for the given problem.
6. Describe the importance of handling uncertainty in supply chain using decision tree.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Understanding of Supply Chain**<br>Introduction to Supply Chain Management, Evolution of Supply Chain Management, Analytics in Supply Chain Management, Supply Chain Planning, Different views of Supply Chain. | 06 |
| 2. | **Supply chain drivers and obstacles** | 06 |

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|---|---|---|
| | Four drivers of supply chain- inventory, transportation, facilities and information; A framework for structuring drivers in supply chain, supply chain strategies, strategic fit, Obstacles to achieve strategic fit, value of information. | |
| **3.** | **Demand forecasting in Supply chain**<br>Bullwhip Effect and Time Series Analysis, Exponential Smoothing Method of Forecasting, Measures of Forecasting Errors, Tracking Signal and Seasonality Models, Forecasting using multiple characteristics in Demand Data and Inventory Management in Supply Chain. | **06** |
| **4.** | **Inventory Management in supply chain**<br>Inventory Management in Supply Chain, Role of cycle inventory, Economics of scale to exploit fixed costs and discounts, cycle time related costs, levels of safety, single stage inventory model, risk pooling, centralized and decentralized systems of planning inventory in supply chain, Multi echelon Inventory Management. | **06** |
| **5.** | **Network Design and analytics in supply chain**<br>Network design, warehouse location, service level requirements, integrating inventory positioning and network design, supply chain integration, Optimal Level of Product Availability in Supply chain.<br>Time Value of money in Supply Chain, Different types of Analytics in Supply Chain. | **06** |
| **6.** | **Handling uncertainty and future trends of Supply chain**<br>Using Decision Tree for handling Uncertainty, Example of using Decision Tree incorporating Uncertainty in Single Factor, Example of using Decision Tree incorporating Uncertainty in two Key Factors, Modelling Flexibility in Supply Chain, Trends, Challenges and Future of Supply Chain. | **06** |

**References:**

**Text books:**

- Supply Chain Management: Strategy, Planning, and Operation, Sunil Chopra and Peter Meindel, Prentice Hall.

**Reference Books:**

- logistics and supply chain management, Christopher martin, Pearson Education Asia.
- Marketing logistics: A supply chain Approach, Kapoor KK; Kansal Purva, Pearson Education Asia.
- Designing and managing supply chain concepts, strategies and case studies, David Simchi-Levi, Ravi Shankar; McGraw Hill Publication.

| Class: - **T.Y. B. Tech.** | Semester- **VI** |
|---|---|
| Course Code: **OE346** | Course Name: **Mobile Robotics** |

| L | T | P | Credits |
|---|---|---|---|
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**Course Description:**
Mobile robotics refers to the field of robotics that focuses on the design, construction, operation, and use of robots that are capable of autonomous movement. Unlike stationary robots, mobile robots have the ability to navigate and operate in various environments, both indoor and outdoor, without being confined to a fixed location.
Key components and aspects of mobile robotics include1. Sensors 2. Actuators 3. Control Systems 4. Power Systems 5. Communication 6. Autonomy.
One of the defining features of mobile robots is their ability to operate autonomously, meaning they can make decisions and navigate without direct human intervention. This autonomy can range from simple behaviors, like obstacle avoidance, to complex tasks such as mapping an unknown environment. Applications of mobile robotics are diverse and include Autonomous Vehicles: Self-driving cars, drones, and other autonomous vehicles are examples of mobile robots used for transportation and surveillance.
Warehouse Automation: Mobile robots are employed in warehouses for tasks such as inventory management, order picking, and transportation of goods.
Search and Rescue: Mobile robots equipped with sensors and cameras can be deployed in disaster-stricken areas to search for survivors or assess the situation.
Agriculture: Agricultural robots can be used for tasks like planting, harvesting, and monitoring crops.
Healthcare: Mobile robots can assist in hospitals for tasks like delivery of supplies, patient assistance, or disinfection.
Mobile robotics is an interdisciplinary field that combines elements of computer science, mechanical engineering, electrical engineering, and other related disciplines to create intelligent and adaptable robotic systems capable of navigating and performing tasks in dynamic environments. Advances in mobile robotics continue to drive innovation in various industries, making these systems increasingly capable and versatile.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Identify and explain the main components of a robot, including sensors, actuators, and control systems.
2. Solve forward and inverse kinematics problems for mobile robots.
3. Apply basic motion planning algorithms such as A* and Dijkstra's algorithm.
4. Apply Simultaneous Localization and Mapping.
5. Implement inter-robot communication and human-robot interaction.

**Prerequisite:** Basics of algebra, kinematics.

| Course Content | | |
|---|---|---|
| **Unit No.** | **Description** | **Hrs** |
| **1.** | Robot locomotion: Types of locomotion, hopping robots, legged robots, wheeled robots, stability, manoeuvrability, controllability. | **06** |
| **2.** | Robot components and applications, sensors and actuators in mobile robots, robot control architecture, introduction to microcontroller science embedded systems. | **06** |
| **3.** | Kinematics and Dynamics-robot kinematics -forward and inverse kinematics,<br>Robot dynamics-Newton-Euler equations, Lagrange's equations. holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots. | **06** |
| **4.** | Motion Planning and Path following-basics of motion planning, path planning algorithms based on A-star, Dijkstra, Voronoi diagrams, probabilistic roadmaps (PRM), rapidly exploring random trees (RRT), Markov Decision Processes (MDP), stochastic dynamic programming (SDP), trajectory generation and control for robots.<br>Localization and Mapping-sensor based localization simultaneous localization and mapping (SLAM), types of maps in mobile robots. | **06** |
| **5.** | Perception for Mobile Robots-computer vision for mobile robots, sensor fusion, object detection and recognition.<br>Control system for mobile robots-PID control, model predictive control (MPC), reactive and deliberative control strategies. | **06** |
| **6.** | Mobile Robot Communication-wireless communication for mobile robots, inter robot communication, human robot interaction. | **06** |

**References -**

**Textbooks:**


- R. Siegwart, I. R. Nourbakhsh, "Introduction to Autonomous Mobile Robots", The MIT Press.
- "Robotics: Modelling, Planning and Control" by Bruno Siciliano and Lorenzo Sciavicco.
- "Probabilistic Robotics" by Sebastian Thrun, Wolfram Burgard, and Dieter Fox.


**Reference Books:**


- Peter Corke, Robotics, Vision, and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics.


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| Class:- **T. Y. B. Tech** | Semester: **VI** |
|---|---|
| Course Code: **OE352** | Course Name: **Image Processing** |

| L | T | P | Credits |
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**Course Description:**
Image Processing has fundamental importance to fields where images are enhanced, manipulated, and analyzed. They play a key role in remote sensing, medical imaging, inspection, surveillance, autonomous vehicle guidance, and more. Students will benefit from the direct visual realization of image processing concepts, and learn how to implement efficient algorithms to perform or design applications for various tasks.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Explain different concepts and processes in digital image processing.
2. Apply different image processing operations on an image.
3. Analyze various operations on image using different tools.
4. Compare various filtering, enhancement, segmentation and classification techniques used in image processing.
5. Design various applications in Image Processing.

**Prerequisite:** Basic knowledge of Linear Algebra and programming language

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Digital Image Fundamentals**<br>Components of image processing system, human and computer vision, hierarchy of image processing system, applications, image formation and digitization, binary, gray scale and color images. | 06 |
| 2. | **Image Enhancement & Image Filtering**<br>Gray level transformation function: Image Negatives, Log Transformations, Power Law Transformation, Piecewise Linear Transformation Functions, Histogram equalization, Basics of spatial filtering, smoothening and sharpening spatial filter. | 06 |
| 3. | **Morphological Image Processing**<br>Dilation and erosion, opening and closing operation, Hit or miss transformation, Edge Detection, Applications of Morphological Image Processing. | 06 |
| 4. | **Image Segmentation**<br>Thresholding, Role of illumination, global and adaptive thresholding, pixel-based segmentation, region-based segmentation and edge-based segmentation. | 06 |

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| **5.** | **Image Shape and Classification**<br>Shape representation, Feature space, Clusters and classification techniques, Supervised and Unsupervised classification, Basic algorithms: Boundary extraction, region filling, thinning and thickening, skeletons. | **06** |
| **6.** | **Real Life Applications and Case Studies**<br>Face recognition, Object detection, Object Classification, various case studies and applications of Digital Image Processing. | **06** |

**References-**

**Text Books:**


- R.C. Gonzalez & R.E. Woods, Digital Image Processing, Pearson.
- Pratt W.K, Digital Image Processing, John Wiley & Sons.


**Reference Books:**


- R.C. Gonzalez & R.E. Woods, Digital Image Processing using MATLAB, Pearson.
- Georgy Gimel' farb, Patrice Delmas, Image Processing and Analysis: A Primer, World Scientific.


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| Class:- **T. Y. B. Tech** | Semester: **VI** |
|---|---|
| Course Code: **OE354** | Course Name: **Fuzzy Logic and Neural Network** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This comprehensive course delves into the core principles of Soft Computing, covering topics such as fuzzy sets and operations, relations and composition, and fuzzification and defuzzification. Students will gain a solid understanding of soft computing methodologies, including the distinctions between soft and hard computing, and the role of biological neural networks in computational models. The course further explores neural network fundamentals, including various learning mechanisms and architectures, paving the way for advanced topics such as recurrent neural networks and their applications.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Develop a comprehensive understanding of fuzzy sets, operations, and their applications in problem-solving scenarios.
2. Solve problems related to relations and composition.
3. Design, implement various neural network architectures.
4. Analyze various neural network architectures for real-world applications.

**Prerequisite:** Basic knowledge of probability and control system

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Foundations of Fuzzy Sets**<br>Fuzzy sets and membership, Universe of discourse, Classical sets operations and properties, Fuzzy sets operations and properties, Mapping of Classical Sets to Functions, Problems based on Fuzzy sets operations and properties. | 06 |
| 2. | **Fuzzy Relations and Operations**<br>Cartesian product, Cardinality of Crisp Relation, crisp relations, fuzzy relations, Operations on Fuzzy Relations Properties of Fuzzy Relations, membership functions, Composition, Fuzzy Cartesian Product and Composition, Value Assignments, Problems based on relation and composition. | 06 |
| 3. | **Membership Functions, Fuzzification and Defuzzification**<br>Features of the Membership Function, Fuzzification, Defuzzification to Crisp Sets, $\lambda$-Cuts for Fuzzy Relations, Defuzzification to Scalars, Problems based on $\lambda$-Cuts and Fuzzy Relations, Fuzzy Control system. | 06 |
| 4. | **Introduction to Soft Computing and Neural Networks** | 06 |

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|---|---|---|
| | What is soft computing? Differences between soft computing and hard computing, Biological Neural Networks, The Journey of Neural Networks, Activation Function, Soft Computing constituents. | |
| 5. | **Neural Networks and Learning Mechanisms**<br>Learning, Supervised Learning, Unsupervised Learning, Supervised mechanism, Unsupervised Mechanism, Reinforcement Learning, Learning Rules, The Perceptron learning, Architecture of Neural Networks, Feedforward Networks, Multilayer feedforward network. | 06 |
| 6. | **Advanced Neural Networks and Applications**<br>Recurrent Neural Network or Feedback Network, Backpropagation Networks, Radial Basis Function Network, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing. | 06 |

**References:**

**Text Books:**


- Kuntal Barua and Prasun Chakrabarti, Fundamentals of Soft computing, BPB Publications.
- S.N. Shivanandam, Principle of soft computing, Wiley.
- Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India.
- James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson publication.


**Reference Books:**


- Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall.
- David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley.


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| Class:-**T.Y. B. Tech** | Semester-**VI** |
|---|---|
| Course Code: **OE356** | Course Name: **Project Management** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course description:**
To improve and update knowledge of new entrepreneurs in the areas of project preparation & appraisal techniques; decision-making process in the sector of industrial, infrastructure & sustainable opportunities that would lead to improved viability, returns and effective investment decisions. Writing a business plan which can gain interest of the fund providers like venture capitalists and other sources of funding.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Explain concept of project Management.
2. Prepare project analysis.
3. Prepare technical appraisal of selected project.
4. Prepare financial appraisal of selected project.
5. Apply different techniques for project management.

**Prerequisite:**
General knowledge of economics, Project & clear concept about business model.

**Course Content**

| Unit No. | Description | Hrs. |
|---|---|---|
| 1. | **Overview of Project appraisal**<br>Project Development Cycle, Identifying data requirements and analyzing their suitability for preparation of feasibility studies, project formulation, screening for pre-feasibility studies, stages of feasibility report preparation, Project Analysis including Market Analysis, Technical Analysis & Financial Analysis, applying various techniques and integrating the data gathered into a full-fledged business plan. | 07 |
| 2. | **Project Analysis**<br>Environmental Analysis, Risk Analysis, Infrastructure Development & Financing, Risk Management, Risk identification, Qualitative risk analysis, Quantitative risk analysis, Risk planning, Risk control, Evaluating the rewards & risks for sustainable opportunities. National Cost-Benefit Analysis, Financing Sustainable Opportunities. | 06 |
| 3. | **Project Planning**<br>Planning fundamentals, project master plan, work breakdown structure & other tools of project planning, work packages project organization structures | 06 |

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| | & responsibilities, responsibility matrix ,Time and cost estimates with AON and AOA conventions, Budget estimates, Network analysis, Float analysis, crashing concepts. | |
| **4.** | **Project appraisal: Technical Appraisal**<br>Operation and Production Plan: Types of production systems, Product design and analysis, New product development, location and layout decisions, project layout, plant and technology choices, product specification and customer needs, production planning and control, Commercializing Technologies. | **06** |
| **5.** | **Commercial Appraisal**<br>Economic feasibility and commercial viability, market analysis, Market Research, Industry Analysis, Competitor analysis, defining the target market, market segmentation, market positioning, building a marketing plan, market strategy.<br>**Financial Appraisal**:<br>Pro-forma income statements, financial projections, working capital requirement, funds flow and Cash flow statements; Ratio Analysis. | **06** |
| **6.** | **PERT, CPM, Resource allocation**<br>Tools & techniques for scheduling development, crashing of networks, time-cost relationship, and resource levelling multiple project scheduling.<br>Computer applications and Software for Project Management. | **05** |

**References -**

**Text Books:**


- Dwivedi, A.K.: Industrial Project and Entrepreneurship Development, Vikas Publishing House.
- Prasanna Chandra: Project Planning estimation and assessment.
- Gray and Larson: Project Management the Managerial Process, Third edition, Tata McGraw-Hill.


**Reference Books:**


- Bangs Jr., D.H., *The Business Planning Guide,* Dearborn Publishing Co.
- Katz, J.A. and Green, R.P., Entrepreneurial Small Business, McGraw Hill.
- Mullins, J. and Komisar R., Getting to Plan B, Harvard Business Press.
- O'Donnell, M., The Business Plan: Step by Step, UND Center for Innovation.
- Scarborough, N.M. and Zimmerer, T.W., Effective Small Business Management, Pearson.
- Pickle, H.B. and Abrahamson, R.L., Small Business Management, Wiley.
- Desai, V., Dynamics of Entrepreneurial Development & Management, Himalaya Publishing.
- Kao, J., Creativity & Entrepreneurship, Prentice Hall.
- Singh, Narendra, Project Management & Control, Himalaya Publications.


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To be implemented for 2024-28 NEP Batch
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| Class:- **T. Y. B. Tech** | Semester: **VI** |
|---|---|
| Course Code: **OE370** | Course Name: **AI for Sustainability** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course introduces the fundamental concepts of artificial intelligence (AI) and sustainability and applications for sustainable development. The course aims to enable learners to understand the potential of AI for addressing environmental, social and economic sustainability challenges through case studies and real-life solutions. Students will explore environmental, social and economic dimensions of sustainability and identify AI appropriateness in each context. They will also evaluate the impact of AI projects in different dimensions and discuss crucial critical consideration.
The course will be Open Elective choice for all students

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Explain fundamentals of Artificial Intelligence and Sustainability.
2. Analyze the potential and impacts of AI to address environmental, social and economic challenges.
3. Develop critical thinking skills for evaluating and comparing AI solutions in sustainable context.
4. Apply AI, IOT and other technologies to prototype sustainable solutions for real-world challenges.

**Prerequisite:** Basic knowledge of Environmental and Sustainability knowledge, Basics of Mathematics and Programming skills.

| Course Content | | |
|---|---|---|
| **Unit No.** | **Description** | **Hrs** |
| 1. | **Introduction to AI and Sustainability**<br>Introduction to Sustainability, Approaches to Sustainability, Dimensions of Sustainability, Introduction to AI and Domains of AI, AI Ethics, AI Contributing to Green Skills, AI's role in achieving sustainability goals. | 06 |
| 2. | **AI Foundations**<br>Supervised, unsupervised, reinforcement learning, Introduction to Neural networks and deep learning, Tools and frameworks for AI: Python, TensorFlow, Scikit-learn. | 06 |
| 3. | **Environmental Sustainability**<br>Introduction to Environmental Sustainability, Business Approach for Environmental Sustainability, AI for Environmental Sustainability, | 06 |

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| | | |
|---|---|---|
| | Environmental Challenges for AI, AI in Clean water and sanitation, AI in Climate Action, AI in Affordable and Clean Energy. | |
| **4.** | **Social Sustainability**<br>Introduction to Social Sustainability, Business Approach for Social Sustainability, AI for Social Sustainability, Social challenges for AI, AI in Zero Hunger, Good Health and Well-being, AI in Accident Detection. | **06** |
| **5.** | **Economic Sustainability**<br>Introduction to Economical Sustainability, Business Approach for Economical Sustainability, AI for Economical Sustainability, Economical Challenges for AI, AI in Decent Work and economic growth, AI in Industry Innovation and Infrastructure, AI in Intelligent Recycling. | **06** |
| **6.** | **Case Studies and AI Projects**<br>Steps in AI Project Development, AI in Quality Education, Transportation, healthcare chatbot, Fraud Detection Predictive Maintenance, Sentiment Analysis for social media. | **06** |

**References:**

**Text Books:**


- Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson.
- Margaret Robertson, "Sustainability Principles and Practice", Routledge.
- S. Suresh, "Artificial Intelligence for Sustainable Development", Wiley.


**Reference Books:**


- Francisco J. Martin and Uwe Meinberg, "Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies", Springer.
- Klaus Schwab "The Fourth Industrial Revolution", Crown Publishing Group.
- Peter Dauvergne "AI in the Wild: Sustainability in the Age of Artificial Intelligence", MIT Press.
- Srikanta Patnaik, Siddhartha Bhattacharyya, Nilanjan Dey (Eds.), "Smart Intelligent Computing and Applications", Springer.


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| Class:- **T. Y. B. Tech** | Semester: **VI** |
|---|---|
| Course Code: **OE3242** | Course Name: **Marketing for Engineers** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
Marketing is the core of operating any business. Marketing defines & guides companies for interfacing with customers, competitors, collaborators, and the environment. Marketing helps you plan and execute the creating a value proposition by determining pricing, promotion, and distribution of ideas, goods, and services. It begins with needs and wants determination, assessing the five forces existing in the competitive environment. Selecting the most appropriate customer targets and developing marketing strategy and implementation program for an offering that satisfies consumers' needs better than the competition. Marketing is the art and science of creating customer value in exchange it benefits the organization and its stakeholders.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Assess market opportunities by analyzing customers, competitors, collaborators, and the strengths and weaknesses of a company.
2. Develop effective marketing strategies to achieve organizational objectives.
3. Design a strategy implementation program to maximize its chance of success.
4. Examine how marketing strategies impact the profitability of an organization
5. Communicate and defend your recommendations to your classmates both quantitatively and qualitatively.

**Prerequisite:**
- No prerequisites are needed for enrolling into this Open Elective course.

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs.** |
| **1.** | **Introduction to Marketing**<br>Core concept of marketing, Marketing Process, Function of Marketing Environment, Analyzing needs & trends in micro, macro business environment. | **06** |
| **2.** | **Market Segmentation, Targeting & Positioning**<br>Basis for market Segmentation, Targeting, Positioning. Marketing Mix, Significance of competitive environment. | **06** |
| **3.** | **New Product Development**<br>Product and product line decisions. Product life cycle (PLC), Managing PLC, Test marketing and the new product, Branding and Packaging decisions. | **06** |
| **4.** | **Pricing & Distribution** | **06** |

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|---|---|---|
| | Price determinants, policies, Methods. Channel Management, Channel conflict and resolutions. | |
| **5.** | **Promotion**<br>Promotion mix, Advertising, Media decisions, Sales Promotion, Personal selling, Managing sales force. Global Marketing. | **06** |
| **6.** | **Strategy**<br>An Introduction, Dealing with competition, Porter's five force model, Strategy, Strategy execution. | **06** |

**References -**

**Text Books:**


- Philip Kotler, Kevin Lane Keller, "Marketing Management" Pearson Publications.
- Rajan Saxena, "Marketing Management", The McGraw-Hill Companies Publication.


**Reference Books:**


- Vijay Prakash Anand, "Marketing Management - An Indian Perspective" Wiley India Pvt. Ltd.
- Joel R. Evans, Berry Berman - "Marketing Management".
- James C. Anderson James A. Narus das Narayandas, "Business Market Management: Understanding, Creating, and Delivering Value", Prentice Hall.
- Stephen Wunker, "Capturing New Markets: How Smart Companies Create Opportunities Others Don't", McGraw-Hill Education.


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| Class:- **T.Y.B. Tech.** | Semester-**VI** |
|---|---|
| Course Code: **CEMD302** | Course Name: **Environmental Engineering** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
Environmental Engineering course offered as MDM in 6th semester, which focuses on water supply engineering and wastewater treatment, solid waste management and air pollution. The course enables students to work as a consultant or contractor for infrastructure projects related to water supply and waste management projects. This course intends to build the competency in the students to identify water source, to check water quality, to design of water supply scheme and wastewater treatment plant. Also, this course enables student to control environmental degradation by using AI tools.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Explain importance of water and wastewater analysis for various parameters.
2. Discuss impact of pollution on man, animal and plants.
3. Prepare layout of water and wastewater treatment process.
4. Design Water and Wastewater Treatment Plant.
5. Apply AI tools for impact of humans on environment.

**Prerequisite:** Basic knowledge of Environmental Science.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Public Health Engineering**<br>Introduction to Water Supply Engineering (WSE) Sources of Water and quality issues, water quality requirements for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. | 06 |
| 2. | **Water Treatment Process**<br>Layout of Water Treatment Plant, Aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes, design problems on water treatment process, application of SCADA for water treatment plant | 06 |
| 3. | **Sewage and Storm Water Collection system** | 06 |

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|---|---|---|
| | Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification, and design of Storm water; Sewage and Sludge, Pollution due to improper disposal of sewage. | |
| 4. | **Wastewater Treatment Process**<br>Layout of Sewage Treatment Plant, wastewater treatment-Physical, chemical and biological treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes, design problems on components of wastewater treatment, Applications of SCADA for STP operations. | 06 |
| 5. | **Solid Waste Management**<br>Solid waste, physical and chemical composition of solid waste, Functional elements of solid waste, Treatment and disposal of solid waste and Integrated solid waste management, application of remote sensing and GIS for SWM. | 06 |
| 6. | **Air Pollution and Control**<br>Air pollution, effects of air pollution on man material and vegetation, Metrological aspects of air pollution, Control of air pollution, Vehicular pollution, Global issues of environment viz. Global warming, acid rain, ozone layer depletion, Applications of AI tools for control of air pollution. | 06 |

**References:**

**Text Books:**


- Punmia B. C. "Water Supply Engineering" Lakshmi Publications Pvt. Ltd. New Delhi
- Punmia B. C."Wastewater Treatment and Reuse" Lakshmi Publications Pvt. Ltd. New Delhi
- Modi P. N. "Water Supply Engineering" Standard Book House, New Delhi
- Modi P. N. "Wastewater Treatment and Reuse" Standard Book House, New Delhi
- Rao M. N.&Datta A. K. "Wastewater Treatment" Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.


**Reference Books:**


- Metcalf and Eddy, "Wastewater Engineering: Treatment & Reuse" Tata McGraw Hill Publication.

| Class:- **T.Y. B. Tech.** | Semester-**VI** |
|---|---|
| Course Code: **CSMD302** | Course Name: **Artificial Intelligence** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | – | – | 3 |

**Course Description:**
In this course students will learn the basic concepts and techniques of Artificial Intelligence. These students will be able to develop AI algorithms for solving practical problems.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:

1. Explain fundamental concepts and applications of AI
2. Apply appropriate search techniques and heuristic methods to solve them efficiently.
3. Describe appropriate knowledge representation using logic inference.
4. Analyze the Planning and Understanding schemes for the goal stack.
5. Analyze Understanding, perception, constraint-based reasoning
6. Evaluate Modern AI applications and ethical considerations

**Prerequisite:** Basic knowledge of logical reasoning and Probability theory.

| Course Content | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs.** |
| **1.** | **Introduction**<br>Definition and history of Artificial Intelligence, Scope of Artificial Intelligence, Agents and Environment, Concept of Rationality, The nature of Environment, The structure of Agents. | **06** |
| **2.** | **Problem Solving and Search Techniques**<br>Problem-Solving Agents, Production systems, Problem Characteristics, Heuristic functions: Hill climbing and local search techniques, Best-First search, Constraint Satisfaction Problems (CSP). | 06 |
| **3.** | **Knowledge Representation and Logic**<br>Propositional logic: syntax and semantics, Predicate logic: quantifiers, inference rules, Resolution principle in propositional and predicate logic, Knowledge representation techniques: Procedural Vs. Declarative Knowledge. | 06 |
| **4.** | **Planning**<br>Planning problems and components, Goal stack planning, Nonlinear Planning using Constraint Posting, Hierarchical Planning, Partial order planning (introduction), planning in deterministic environments | 06 |
| **5.** | **Understanding**<br>Level of interactions among components, understanding as a constraint satisfaction, Line labeling, The Waltz algorithm. | 06 |
| **6.** | **Modern AI Applications**<br>AI applications: Healthcare, Finance, And Robotics, Autonomous systems, Case studies of AI systems, societal impact and ethics of AI. | 06 |

**References:**

**Text Books:**

- Artificial Intelligence by Rich and Knight, The McGraw Hill publication
- Artificial Intelligence: A modern approach by Stuart Russel, Peter Norvig, Pearson Education.

**References:**

- https://www.edx.org/course/artificial-intelligence-ai
- https://www.udemy.com/course/artificial-intelligence-az/

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| Class:- **T.Y.B. Tech.** | Semester- **VI** |
|---|---|
| Course Code: **EEMD302** | Course Name: **Smart Grid** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | -0 | 3 |

**Course Description:**
This course covers the fundamental aspects of the smart grid, various technologies, communication and applications of renewable sources for developing smart grid. It introduces state of the art smart grid technologies like electric vehicles, microgrids, energy storage, phasor measurement unit and cyber security, etc. In addition, it discusses the architecture of smart gird, various distributed energy sources, smart metering and distribution automation equipment.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:

1. Summarize the concept and future of smart grid
2. Develop smart grid architecture
3. Compile various smart grid technologies
4. Identify communication and information technologies for smart grid
5. Elaborate distributed generation and storage technologies
6. Recommend smart metering and distribution automation

**Prerequisite:** Fundamentals of Power system.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to smart grid**<br>Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India, comparison between smart grid and micro grid, Grid Codes. | 06 |
| 2. | **Smart grid architecture**<br>Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, centralized, distributed and hierarchical control strategies, power line communications, supervisory control and data acquisition system. | 06 |
| 3. | **Communication technology in smart grid**<br>Introduction to communication technology, Home Area Network (HAN), Neighborhood Area Network (NAN) and Wide Area Network (WAN), two-way digital communications paradigm, synchro-phasor measurement units (PMUs) – wide area measurement systems (WAMS), Introduction to Internet of things (IoT)- Applications of IoT in Smart Grid. | 06 |

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|---|---|---|
| 4. | **Information technology in smart grid**<br>Data communication, dedicated and shared communication channels, switching techniques- circuit switching, message switching, packet switching, virtual packet switching, datagram packet switching, standards for information exchange, information security for the smart grid, | 06 |
| 5. | **Distributed generation and storage**<br>Introduction to distributed energy sources, solar PV system, wind energy system, microgrids, microgrid architecture, AC micro grid, DC microgrid, storage technologies- battery, super capacitor, compressed air energy storage, pumped hydro energy storage, introduction electric vehicles- vehicle to grid (V2G), grid to vehicle (G2V), vehicle to vehicle (V2V) and vehicle to home (V2H) operation in smart grid. | 06 |
| 6. | **Smart metering & distribution automation**<br>Evolution of electricity metering, key components of smart metering, overview of the hardware used, communications infrastructure for smart metering and protocols for smart metering, equipment's used in smart grid - current transformers, voltage transformers, intelligent electronic device, bay controller, remote terminal units, components for fault isolation and restoration, fault location. | 06 |

**References -**

**Text Books:**


- Janaka Eknayake, "Smart Grid- Technology and applications", Wiley publications.
- A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Application", Springer.


**Reference Books:**


- S. Borlase, "Smart Grids, Infrastructure, Technology and Solutions", CRC Press.
- G. Masters, "Renewable and Efficient Electric Power System", Wiley–IEEE Press.
- T. Ackermann, "Wind Power in Power Systems, Hoboken", N J, USA, John Wiley.

| Class:- T.Y. B. Tech. | Semester-VI |
|---|---|
| Course Code: ECMD302 | Course Name: Industrial Electronics |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course provides basics of power electronic devices with switching on/off techniques. It also deals with power converters such as AC to DC, DC to DC and DC to AC with their analysis and performance parameters. This course also gives introduction to PLC.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Identify basics Power Electronics devices and components.
2. Illustrate use of Power Electronics.
3. Develop PLC logic using ladder programming.
4. Analyze industrial electronics applications.

**Prerequisite:** Knowledge of basic electronics and programming.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Power Electronic Components**<br>Applications of power electronics, Power Electronic System, Power semiconductor devices: power diode, power BJT, Power MOSFET, IGBT, SCR, Diac, TRIAC, Ratings, control characteristics of power devices, Characteristics and specifications of switches, Types of power electronic circuits. | 06 |
| 2. | **Power Converters**<br>AC-DC Converters (Rectifiers), DC-DC converters (choppers), DC-AC converter (Inverters), AC-AC Converters (1-phase, 3-phase) Cycloconverters. | 06 |
| 3. | **DC and AC Drives**<br>Basic characteristics of DC motor, operating modes, DC motor control using choppers and rectifiers, Torque-speed characteristics of induction motor, speed control techniques of AC motor: stator-voltage, rotor resistance, and v/f control, basic equations, characteristics. | 06 |
| 4. | **Introduction to PLC**<br>Introduction about industrial automation, History of industrial automation Need of automations in industries, Automation control circuit and power circuit, Control system in Industry, Types of PLCs. | 06 |

| | | |
|---|---|---|
| 5. | **PLC Programming**<br>Types of Programming Languages, Introduction about PLC Programming software, Ladder logic diagram, Structure of program, Procedure for creating ladder diagram, Logical function done by ladder program in software. | 06 |
| 6. | **Applications**<br>Industrial conveyor systems, Automatic Bottle Filling System, Traffic Light Control system, UPS, Battery charging circuits and management Systems, Induction heating and dielectric heating. | 06 |

**References -**

**Text Books:**


- M. H. Rashid, Power Electronics Circuits Devices And Applications, PHI.
- C. D. Johnson, Introduction to process technologies, PHI.


**Reference Books:**


- M. D. Singh and K. B. Khanchandani, Power Electronics, TMH.
- P. C. Sen, Power Electronics, S. Chand publication.


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| Class:- **T.Y.B. Tech.** | Semester-**VI** |
|---|---|
| Course Code: **CIMD302** | Course Name: **Software Engineering** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
This course deals with various concepts of Software Engineering. It includes concepts such as software requirements, software process models, function-oriented and object-oriented design. Software engineering covers the basic concepts such as data analysis, modeling and design required for developing software. It also covers concepts such asObjects, classes, links and associations, generalization and inheritance, aggregation, abstract classes and advanced modeling concepts in UML.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Describe fundamental concepts in software engineering and project management
2. Practice software process models for the undertaken software problems
3. Design function-oriented and object oriented models using modern tools.
4. Identify classes and build the domain model using advanced concepts in object, dynamic and functional modeling.
5. Analyze existing software systems using function and object-oriented analysis.
6. Design models using UML diagrams for software systems: use case, class, sequence, collaboration, activity, state chart diagrams, component and deployment.

**Prerequisite:** Fundamentals of Computers.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Software Requirements, Analysis and Specification** Software requirement analysis and specification, problem analysis, Requirement Specification, Validation, effort estimation, risk management, software testing types. | 06 |
| 2. | **Software Process Models** Waterfall model, V model, Prototyping, Spiral model, Agile software development. | 07 |
| 3. | **Function-oriented Design** Design principles, module level concepts, Design notation and specification, structured design methodology, Verification. | 05 |
| 4. | **Structural Modeling using UML** Classes, Relationships, Common mechanisms. Diagrams, Class Diagrams, Interfaces, Types and Roles, Packages, Instances and Object Diagram. | 06 |

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|---|---|---|
| 5. | **Behavioral Modeling and Architectural Modeling using UML**<br>Interactions, Use cases, Use case diagram, Activity diagrams, Events and signals, State Machines, Components, Deployment, Collaboration, Patterns and Frame works, Component diagrams and Deployment Diagrams. | 06 |
| 6. | **Case studies:**<br>A. Case study on DFD for Hospital Management System, Library Management System, Railway Reservation System and Online Shopping System.<br>B. Case study design using UML on Banking system, College management system, online food ordering system. | 06 |

**References -**

**Text Books:**

- Pankaj Jalote, "An Integrated Approach to S/W Engineering.", Narosa Publication House.
- Grady Booch, JeamsRambaugh, Ivar Jacotson, "The Unified Modeling Language User Guide" (Addison Wesley).

**Reference Books:**

- Roger S. Pressman, "Software Engineering - Practitioner's Approach", TATA McGraw-Hill.

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| Class: - **T. Y. B. Tech.** | Semester-VI |
|---|---|
| Course Code: **MEMD304** | Course Name: **Marketing and Business Fundamentals for New Products** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | -- | -- | 3 |

**Course Description:**
In this course, students will learn and understand essential principles and strategies required for successfully launching new products in today's competitive market landscape. From understanding consumer behavior to developing effective branding strategies, students will gain the knowledge and skills necessary to navigate the complexities of bringing innovative products to market.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Explain product positioning and branding strategies for new products
2. Analyse market trends and consumer behaviour to identify opportunities for new product development.
3. Develop pricing strategies and cost estimation techniques for new products
4. Explain the basics of intellectual property rights and patents in the context of new product development
5. Design distribution channels and sales strategies designed for anew products
6. Create effective marketing communication plans and launch strategies for new products.

**Course Content**

| Unit No | Description | Hrs. |
|---|---|---|
| 1. | **Product Positioning and Branding Strategies** Understanding the concept of product positioning, Identifying target markets and audience segmentation, Crafting a compelling brand identity, Developing brand positioning strategies, Case studies and real-world examples of successful branding campaigns. | 06 |
| 2. | **Market Analysis and Segmentation** Conducting market research to identify opportunities and threats, Analysing market trends and consumer behaviour, Segmentation techniques for targeting specific market segments, Assessing market competition and differentiation strategies, Utilizing data analytics tools for market analysis. | 06 |
| 3. | **Pricing Strategies and Cost Estimation** Factors influencing pricing decisions, Cost estimation methods for new product development, Pricing strategies: skimming, penetration, value-based pricing, etc., Pricing psychology and consumer perceptions, Pricing models and simulations. | 06 |
| 4. | **Basics of Intellectual Property Rights and Patents** | 06 |

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|---|---|---|
| | Understanding intellectual property rights (IPR), Overview of patents, trademarks, copyrights, and trade secrets, Importance of protecting intellectual property for new products, Patent application process and requirements, Case studies on patent infringement and legal implications. | |
| **5.** | **Distribution Channels and Sales Strategies:** Exploring various distribution channels: direct vs. indirect, Channel selection and management, Developing sales strategies and distribution plans, Sales forecasting and performance measurement, Building partnerships and alliances for distribution. | **06** |
| **6.** | **Marketing Communication and Launch Strategies:** Crafting effective marketing messages and communication channels, Integrated marketing communication (IMC) strategies, Planning and executing product launches, Leveraging digital marketing tools and social media platforms, Measuring the success of marketing campaigns and adjusting strategies accordingly. | **06** |

**References: -**

**Textbooks:**


- Saxena, Marketing Management: Text and Cases.
- Rao, V.S.P., & Saxena, Marketing Management: Indian Cases.
- Beri, G.C. Indian Marketing: Text and Cases.
- Gandhi, M.K., Kumar, A., & Mowen, J.C. Marketing: Concepts and Cases.


**Reference Books:**


- Kotler P. and KellerK.L, Marketing Management.
- Crawford C.M. and Di Benedetto C.A, New Products Management.
- Armstrong G. and Kotler P, Principles of Marketing.
- Ries, The Lean Startup: How Today's Entrepreneur use Continuous Innovation to Create Radically Successful Businesses.
- Boone L.E. and Kurtz D.L, Contemporary Marketing.

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**T. Y. B. Tech. Syllabus**
To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T.Y. B. Tech.** | Semester-VI |
|---|---|
| Course Code: **MCMD302** | Course Name: **Industrial Robotics** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
Industrial robots are nearly on the verge of revolutionizing Manufacture as they end up noticeably more intelligent, quicker, and less expensive, they are being called upon to accomplish more. They are going up against more "human" abilities and attributes, for example, detecting, expertise, memory, and trainability. Accordingly, they are going up against more employments for example, picking and packaging, testing, or investigating items, or assembling minute gadgets.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Explain the basic concepts of Robots.
2. Select an end effector and sensor for application.
3. Explain drives and controls for robotic system.
4. Develop program for robot to perform tasks in industrial applications.

**Prerequisite:** Sensor and Instrumentation.

**Course Content**

| Unit No. | Description | Hrs |
|---|---|---|
| 1. | **Fundamentals of Robotics**<br>History of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot. | 06 |
| 2. | **Grippers for Robotics**<br>Grippers, Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper systems. | 06 |
| 3. | **Sensors for Robotics**<br>Types of Sensors used in Robotics, Touch Sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Application of Sensors, Characteristics of Sensing devices, Selection for Particular application Case study. | 06 |
| 4. | **Drives and Control for Robotics**<br>Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system, Types of Controllers, Introduction to closed loop control. | 06 |

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|---|---|---|
| 5. | **Programming and Languages for Robotics**<br>Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, ROS. | 06 |
| 6. | **Application of Robotics in Industry**<br>Application of robot in welding, machine tools, material handling, and assembly operations, parts sorting and parts inspection, AI in robotics, Introduction to Cobots, Future Application and Challenges and Case Studies. | 06 |

**References -**

**Text Books:**


- Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, Robotic Engineering - An Integrated Approach, Prentice Hall Department of Industrial Design Detail Syllabi 318NIT Rourkela India, New Delhi.
- Mikell P Groover, Industrial Robotics - Technology, Programming and Applications, McGraw Hill.
- Introduction to Robotics- John J. Craig, Addison Wesley Publishing.


**Reference Books:**


- James A Rehg, Introduction to Robotics in CIM Systems, Prentice Hall of India,
- Deb S R, Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi.
- Janaki Raman P A, Robotics and Image Processing, Tata McGraw Hill.
- Robotics for Engineers - YoramKoren, McGraw Hill International.


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**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class:- **T.Y. B. Tech.** | Semester– **VI** |
|---|---|
| Course Code: **AIMD302** | Course Name: **Principles of AI** |

| **L** | **T** | **P** | **Credits** |
|---|---|---|---|
| **3** | **-** | **-** | **3** |

**Course Description:**
In this course students will learn the basic concepts and techniques of Artificial Intelligence. These students will be able to develop AI algorithms for solving practical problems.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to:
1. Articulate basic concepts and techniques of Artificial Intelligence.
2. Apply AI algorithms for solving typical practical problems.
3. Designate appropriate knowledge representation schemes in AI.
4. Analyze reasoning schemes in AI.

**Prerequisites:** Basic knowledge of logical reasoning, Probability theory

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction**<br>The four categories of definitions of AI, Concept of rationality, The AI Problems, Artificial Intelligence Technique, Tic-Tac-Toe game and its data structure, Question-Answering and its one typical data structure, Sample few examples of the state-of-art AI applications. | 06 |
| 2. | **Intelligent Agents**<br>PEAS description of the task, Simple reflex agents, Model based agents, Learning Agents, advantages, Impact and Examples of AI, Application domains of AI. | 06 |
| 3. | **Problem solving techniques**<br>State space search, control strategies, heuristic search, problem characteristics, production system characteristics, Generate and test, Hill climbing, best first search, A* search. | 06 |
| 4. | **Constraint satisfaction problem**<br>Mean-end analysis, Game playing, Min-Max Search, Alpha-Beta Pruning. Iterative deepening. | 06 |
| 5. | **Logic and Knowledge Representation schemes in AI**<br>Propositional logic, predicate logic, Resolution, Resolution in proportional logic and predicate logic, Clause form, unification algorithm. | 06 |

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|---|---|---|
| 6. | **Reasoning schemes in AI**<br>Introduction to non monotonic reasoning, default reasoning, statistical reasoning, probability and Bayes' theorem, combining uncertain rules. | 06 |

**References -**

**Text Books:**

- Artificial Intelligence by Rich and Knight, The Mc Graw Hill publication
- Artificial Intelligence: A modern approach by Stuart Russel, Peter Norvig, Pearson Education

**Reference Books:**

- Artificial Intelligence | Electrical Engineering and Computer Science | MIT Open Course Ware.

| Class:- **T. Y. B. Tech.** | Semester-VI |
|---|---|
| Course Code: **RAMD302** | Course Name: **Industrial Automation Control** |

| L | T | P | Credits |
|---|---|---|---|
| 3 | - | - | 3 |

**Course Description:**
This course offers a comprehensive overview of industrial automation systems, emphasizing their design, components, and applications in various industries. Students will learn about fundamentals of industrial automation, programmable logic controllers (PLCs), PLC programming, material handling and distributed control systems (DCS).

**Course Outcomes:**
After successful completion of the course, students will be able to-

1. Explain need, basic elements, and systems of industrial automation.
2. Develop PLC programming for various applications.
3. Discuss various material handling and identification technologies.
4. Explain basics of DCS and its interfacing.

**Prerequisite:** NIL

| Course Content | | |
|---|---|---|
| **Unit No.** | **Description** | **Hrs** |
| 1. | **Fundamentals of Industrial Automation**<br>Need of automation, Types of Automation: fixed /programmable /flexible automation, Automation principles and strategies. Basic elements of automated systems: power, program and control, Advanced automation functions: Safety monitoring, Maintenance and Repair diagnostics, Error detection and recovery, Levels of automation. | 06 |
| 2. | **Transfer Lines and Automated Assembly**<br>Fundamentals, Configurations, Transfer mechanisms, storage buffers, control, applications, Analysis of transfer lines with and without storage buffers. Assembly Automation: Types and configurations, Parts delivery at workstations. | 06 |
| 3. | **Fundamentals of PLC**<br>Programmable Logic Controller (PLC)- Block diagram of PLC, PLC architecture and programming languages (Ladder Logic, Function Block Diagram, etc.), Basic instruction sets, Input/output modules. Networking of PLC, Overview of safety of PLC with case studies. | 06 |
| 4. | **PLC Programming** | 06 |

| | | |
|---|---|---|
| | Basic instructions (AND, OR, NOT, Timer, Counter, etc.), Programming techniques (branching, looping, etc.), Program control instructions, PLC applications like motor control, light control etc. | |
| **5.** | **Material handling and Identification Technologies**<br>The material handling function, Types of Material Handling Equipment, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. Automated Storage Systems: Storage System Performance, Automated Storage/Retrieval Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing. Product identification system: Barcode, RFID etc. | 06 |
| **6.** | **Distributed Control System**<br>Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS. | 06 |

**References –**

**Text Books:**

- M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing, Prentice-Hall.

**Reference Books:**

- Webb, John W. Programmable Logic Controllers: Principles and Application, Prentice Hall of India, New Delhi.
- Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
- Lucas, M.P., Distributed Control System, Van Nonstrandreinhold Co. NY.
- Amber G.H & P.S. Amber, Anatomy of Automation, PrenticeHall.

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| Class: - **T. Y. B. Tech.** | Semester-VI |
|---|---|
| Course Code: **AI324** | Course Name: **Higher-Level Coding** |

| L | T | P | Credits |
|---|---|---|---|
| 2 | -- | -- | 2 |

**Course Description:**
This course is designed to equip students with essential problem-solving and algorithmic thinking skills required for competitive programming and technical interviews. Through a hands-on approach, the course covers fundamental and advanced coding techniques using strings, arrays, linked lists, trees, queues, and sorting algorithms. Students will explore a variety of coding challenges such as string reversal, palindrome detection, anagram identification, array chunking, and queue simulation. The course also emphasizes structured thinking through pattern problems and introduces complexity analysis to develop optimized solutions. In the final unit, students engage in mock coding contests and real-time problem-solving scenarios to simulate competitive environments. By the end of the course, students will be well-prepared to participate in online coding platforms (e.g., LeetCode, HackerRank, Codeforces) and succeed in coding rounds of placement and internship drives.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,
1. Apply logic-building techniques using flowcharts, loops, and conditionals.
2. Illustrate algorithmic concepts using visual patterns and mental models.
3. Analyse problems and design modular solutions using standard strategies.
4. Debug code systematically using tracing and test case evaluation.
5. Evaluate and apply appropriate data structures based on problem requirements and resource constraints.
6. Design optimized algorithms by applying complexity analysis techniques

**Prerequisite:**
- Basic Programming Knowledge, Variables, Data Types and Operators, Control Structures, Arrays and Strings, Functions and Modular Programming

| **Course Content** | | |
|---|---|---|
| **Unit No** | **Description** | **Hrs** |
| **1.** | **Foundations of Logic and Computational Thinking**<br>Building flow and decision-making skills using real-world analogies, logic building using flowcharts and dry runs, Decision trees and condition mapping, Basic control structures and logical traps, Boolean logic in problem-solving, Practice problems: conditionals, loops, basic math Platform: HackerRank (Warm-up, Logic). | **04** |
| **2.** | **Understanding Through Intuition** | **04** |

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|---|---|---|
| | Bridging abstract concepts with relatable mental hooks and visual reasoning, Pictorial understanding of recursion, sorting, searching, Visual memory hooks for arrays, stacks, queues, Time-space tradeoffs via real-life analogies, Pattern recognition (e.g., Fibonacci, Pascal Triangle) | |
| 3. | **Algorithmic Thinking & Problem Decomposition**<br><br>Transformation from idea to code through structured breakdowns, Problem parsing & constraint analysis, Mapping problems to data structures, Brute force vs optimized paths, Greedy, recursion, divide & conquer basics, Case-study: converting ideas into code templates | 04 |
| 4. | **Debugging as a Mindset**<br><br>Techniques for iterative problem isolation and logical tracing, Reading test cases & tracing code logic Identifying edge cases, Use of debug logs, breakpoints, Contest-style stress testing, Practice: Fixing buggy codes, "Wrong Answer" case studies | 04 |
| 5. | **Mental Models for Execution**<br><br>How programmers think when choosing tools, structures, and approaches, When to use which data structure, Hashing vs Trees vs Graphs, Memory-efficiency decisions, Real-time constraints and model matching, Practice: Match the approach (e.g., use stack/queue/map). | 04 |
| 6. | **Layered Problem Solving**<br><br>From brute-force approaches to thoughtful optimization strategies, Complexity analysis: Big-O simplification drills, Problem laddering (brute → better → optimal). | 04 |

**References -**
**Tools & Platforms:**
**Tools:**

| | | |
|---|---|---|
| **VisuAlgo** | Visualize data structures and algorithms | https://visualgo.net |
| **Python Tutor** | Step-by-step code execution visualization | http://pythontutor.com |
| **OnlineGDB** | Online compiler with debugging support | https://www.onlinegdb.com |
| **CS50 Visual Demos** | Visual learning for concepts like memory, stacks, etc. | https://cs50.harvard.edu/x |

**Platforms:**

| | | |
|---|---|---|
| **HackerRank** | Warm-up, logic building, basic DS & algo | Start with easy logic problems |
| **LeetCode** | Technical interview prep, DS/Algo depth | Use tag-wise practice (arrays, graphs, DP) |
| **Codeforces** | Timed contests, algorithmic problem solving | For laddered learning, Div 2/3 practice |
| **AtCoder** | Clean problems, logic-first contests | Begin with Beginner Contests |
| **GeeksforGeeks** | Concept building, topic-wise questions | For structured topic learning |
| **BinarySearch.com** | Brute to optimal code transitions | Use for optimization drills (Unit 6) |

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To be implemented for 2024-28 NEP Batch
**Department of Computer Science & Engineering (Artificial Intelligence and Machine Learning)**

| Class: - **T. Y. B. Tech.** | Semester-VI |
|---|---|
| Course Code: **AI326** | Course Name: **Large Language Models** |

| L | T | P | Credits |
|---|---|---|---|
| 1 | -- | 2 | 2 |

**Course Description:**
This course introduces the foundations and applications of Large Language Models (LLMs), covering Transformer architecture, pretraining, fine-tuning, and prompt engineering. Students will gain hands-on experience with state-of-the-art LLMs using tools like Hugging Face and explore deployment techniques, efficiency methods, and ethical considerations.

**Course Learning Outcomes:**
After successful completion of the course, students will be able to,

1. Differentiate between various pretraining, fine-tuning, and prompt-tuning techniques used in LLMs.
2. Apply LLMs to solve NLP tasks such as text classification, summarization, and question answering using open-source frameworks.
3. Design effective prompts and retrieval-augmented pipelines to enhance model performance in real-world scenarios.
4. Demonstrate techniques for efficient training and deployment of LLMs, including quantization and parameter-efficient fine-tuning.
5. Evaluate the ethical and societal implications of LLMs with respect to bias, fairness, and responsible AI use.

**Prerequisite:**

- Machine Learning, Deep Learning, Natural Language Processing.

**Course Content**

| Unit No | Description | Hrs |
|---|---|---|
| 1. | **Introduction to Large Language Models**<br>Evolution from RNNs, LSTMs to Transformers, what makes a model "large"? Parameters, datasets, compute, Key LLMs: BERT, GPT, Use cases and applications (chatbots, translation, summarization, etc.) | 02 |
| 2. | **Transformer Architecture and Pretraining**<br>Transformer basics: self-attention, multi-head attention, positional encoding, Encoder, Decoder, and Encoder-Decoder architectures, Pretraining tasks. | 02 |

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|---|---|---|
| 3. | **Fine-Tuning and Transfer Learning**<br>Fine-tuning vs. prompt-tuning vs. instruction tuning, Domain adaptation strategies, Zero-shot, few-shot, and in-context learning, Alignment of Language Models with Human Feedback (RLHF). | 02 |
| 4. | **Prompt Engineering and Retrieval-Augmented Generation (RAG)**<br>Prompt design: zero/few-shot prompts, chain-of-thought prompts, RAG: combining LLMs with search systems. | 02 |
| 5. | **Scaling Laws, Efficiency, and Deployment**<br>Scaling laws and compute/dataset trade-offs, Efficient LLMs: quantization, distillation, LoRA, PEFT, LLM deployment: inference optimization, APIs, memory management. | 02 |
| 6. | **Societal Impacts, Safety, and Future of LLMs**<br>Ethical issues: bias, hallucinations, misinformation, misuse, Model audits, alignment, and interpretability, Future trends: Multimodal LLMs, agents, open-source vs. proprietary. | 02 |

| Lab Content | | |
|---|---|---|
| **Experiment No** | **Description** | **Hrs** |
| 1 | **Explore Pretrained LLMs using HuggingFace Transformers**<br>Load and run inference with models like BERT and GPT-2. for text generation, text classification and marked word prediction. | 02 |
| 2 | **Visualize Transformer Attention Mechanism**<br>Visualize multi-head attention and token interactions using BERTViz, BertViz-HeadView, TensorFlow/PyTorch. | 02 |
| 3 | **Implement a Mini Transformer Model**<br>Build a simplified version of Transformer encoder in PyTorch. | 02 |
| 4 | **Fine-tuning BERT for Sentiment Classification**<br>Customize a pre-trained BERT model on a sentiment dataset. | 02 |
| 5 | **Text Summarization using T5 Model**<br>Fine-tune T5 on a news summarization dataset. | 02 |
| 6 | **Prompt Engineering with GPT Models**<br>Design and evaluate different prompts for various tasks using zero-shot, few-shot, and chain-of-thought prompts. | 02 |
| 7 | **Building a RAG Pipeline for Q&A**<br>Integrate retrieval and generation for answering questions using LLMs. | 02 |
| 8 | **Apply Quantization and Evaluate LLM Performance**<br>Use post-training quantization to reduce model size and latency. | 02 |

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|---|---|---|
| 9 | **Efficient Fine-Tuning with LoRA or PEFT**<br>Implement parameter-efficient fine-tuning on a text classification task | 02 |
| 10 | **Evaluating LLM Outputs for Bias and Hallucination**<br>Identify and analyze biased or hallucinated outputs. | 02 |

**References -**

**Text Books:**

- Tanmoy Chakraborty, "Introduction to Large Language Models", Wiley India.
- Dan Jurafsky and James H. Martin, "Speech and Language Processing", Pearson Press.
- Lewis Tunstall, Leandro von Werra, and Thomas Wolf, "Natural Language Processing with Transformers", O'Reilly Media.

**Reference Books:**

- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press.
- Denis Rothman, "Transformers for Natural Language Processing", Packt Publishing.

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| Class: - **T. Y. B. Tech.** | Semester – **VI** |
|---|---|
| Course Code: **AI3181** | Course Name: **Mobile Application Development Lab** |

| L | T | P | Credits |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Description:**
Mobile application development covers theory and technologies for the development of distributed applications for mobile devices as well as introducing design principles for applications for small devices. It addresses android for mobile devices. The subject also provides a basis for understanding how different techniques can be used to develop distributed mobile applications. The core modules of this course include designing, developing, testing, signing, packaging and distributing high quality mobile apps. This course aims to teach mobile application development using Android as the development platform.

**Course Learning Outcomes:**
At the end of the course the student should be able to:
1. Setup the Android development environment.
2. Utilize the appropriate User Interface controls in Android app.
3. Implement SQLite and Shared Preferences concepts to store data in Android app.
4. Implement Location and Notification based functionalities in Android app.
5. Design and develop a WebView based Android app.
6. Build and deploy Android app on Google Play Store.

**Prerequisites:**
- Basic knowledge of Programming.
- Basic knowledge of android mobile phone.

**It should consist of 12 experiments based on the syllabus and experimentlist mentioned below.**

| **Course Content** | | |
|---|---|---|
| **Experiment No** | **Description** | **Hrs** |
| **1** | Study & Installation of Android Studio | **02** |
| **2** | Creating Views in Android Studio | **02** |
| **3** | Event Handling | **02** |
| **4** | Android Activity and Intents | **02** |

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|---|---|---|
| 5 | Create Effective user interface. | 02 |
| 6 | Storing data with SQLite. | 02 |
| 7 | Sharing Data: Content resolver and content provider, location and routing. | 02 |
| 8 | Understand Play store Deployment Process. | 02 |
| 9 | Study & Installation of any open-source application and - Create your first app. | 02 |
| 10 | Creating user interface, Design & theming, Interactivity. | 02 |
| 11 | Perform Assets & media and Navigation & routing. | 02 |
| 12 | Implement Animations & transitions and Accessibility & internationalization. | 02 |

**References –**

**Text Books:**

- Anubhav Pradhan, Anil V Deshpande, "Mobile application development".
- Lauren Darcy, ShaneConder, "Teach Yourself Android Application Development In 24 Hours", SAMS Publication.
- -Barry Burd, "Android Application Development All in one for Dummies", Wileys Publication.
- Android Programming: The Big Nerd Ranch Guide (Big Nerd Ranch Guides) KindleEdition.

**Reference Books:**

- Chris Haseman, "Android Essential", Apress Publication the Android Developer's Cookbook, J. Steele, N. To, Addison-Wesley.
- O' Reilly, "Programming Android: Java Programming for the New Generation of Mobile Devices".
- R. Meier, "Professional Android 2 Application Development", Wiley.
- Shane Conder, Lauren Darcey, Addsion Wesely, "Android Wireless Application Development".

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| **Class: - T. Y. B. Tech.** | Semester – **VI** |
|---|---|
| Course Code: **AI328** | Course Name: **Minor Project** |

| **L** | **T** | **P** | **Credits** |
|---|---|---|---|
| - | - | **12** | **6** |

**Course Description:**
The Major Project provides students with an opportunity to solve a real-world engineering problem by applying knowledge acquired throughout the undergraduate program. Students are expected to design, develop, implement, test, validate, and deploy an innovative software or hardware solution using appropriate engineering methodologies and modern development tools. The course emphasizes system design, project management, experimentation, testing, optimization, professional ethics, sustainability, teamwork, entrepreneurship, and effective technical communication. Students are encouraged to develop industry-oriented, research-driven, or socially relevant solutions that demonstrate engineering competence and innovation.

**Course Learning Outcomes:**
Upon successful completion of this course, the student should be able to:
1. Apply knowledge of computer science for real world problem.
2. Possess Professional, Practical and reflective practitioner skills.
3. Upgrade and apply the knowledge through continuous learning.
4. Effectively apply Design Thinking Processes and Template to structure learning lifecycle in the development of a prototype.
5. To develop project management and time management skills.
6. To formulate a process whereby to keep the end-user or customer in mind throughout the project life cycle.

**Prerequisites:**
- Students should have basic knowledge of their respective Project area.

| Course Activities | | |
|---|---|---|
| **Week No** | **Description** | **Hrs** |
| 1 | Course orientation, project allocation, project objectives, literature review, requirement validation, project planning and milestone definition. | **06** |
| 2 | System architecture design, database design, technology selection, feasibility analysis, risk assessment, and Review-I (Project Planning Review). | **06** |
| 3 | Module-wise implementation, coding standards, version control, documentation, and project logbook maintenance. | **06** |
| 4 | Completion of core modules, unit testing, debugging, API integration, and subsystem validation. | **06** |
| 5 | System integration, performance optimization, security implementation, usability enhancement, and Review-II (Implementation Review). | **06** |
| 6 | Functional testing, integration testing, performance testing, and defect resolution. | **06** |
| 7 | Experimental evaluation, result analysis, comparison with existing systems, optimization, and documentation of findings. | **06** |
| 8 | Prototype refinement, deployment preparation, user acceptance testing, and reliability verification. | **06** |
| 9 | Completion of implementation, validation against project objectives, preparation of research paper/patent/prototype documentation, and Review-III (Testing & Validation Review). | **06** |
| 10 | Preparation of technical report, user manual, project documentation, deployment guide, and demonstration material. | **06** |
| 11 | Final report preparation, plagiarism verification, incorporation of review suggestions, presentation rehearsal, and mock viva. | **06** |
| 12 | Final project demonstration, report submission, viva-voce examination, Review-IV (Final Evaluation), and project exhibition. | **06** |

**References -**

**Text Books:**


- Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, McGraw-Hill.
- Robert C. Martin, *Clean Architecture*, Pearson.


**Reference Books:**


- Steve McConnell, *Code Complete*, Microsoft Press.
- Erich Gamma et al., Design Patterns, Addison-Wesley.


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| Class: - **T. Y. B. Tech.** | Semester – **VI** |
|---|---|
| Course Code: **SH3065** | Course Name: **Scholastic Aptitude - II** |

| L | T | P | Credits |
|---|---|---|---|
| 2* | - | - | Audit |

**Course Description:**
Quantitative and Reasoning tests form a major part of most of the competitive exams and recruitment processes. They evaluate numerical ability and problem-solving skills of candidates. Along with the arithmetic abilities, candidate's patience while reading through the question is also tested. Decision making is also a crucial part of the process with a question having multiple solutions and the candidate has to choose the most efficient one. Fast calculations have become an integral part of a candidate's career. Calculating the remuneration and efficiency, estimating profits and interests on the principal, using a logical approach towards solving a problem is now a routine affair for a professional.

**Course Learning Outcomes:**

After successful completion of the course, students will be able to:

1. Develop a thorough conceptual understanding and develop a logical approach towards solving Aptitude and Reasoning problems.
2. Understand usage of basic aptitude terms of percentages, averages, ratios and applications of business aptitude terms of profits and interests.
3. Develop a bridge in analogies, series and visualizing directions.
4. Apply various short cuts & techniques to manage speed and accuracy to get equipped for various competitive and campus recruitment exams.

**Prerequisites:**
- Fundamentals of various Mathematical and Arithmetic operations, Calculations.

**Course Content**

| Unit No | Description | Hrs. |
|---|---|---|
| 1. | **Speed Time Distance**<br>Average Speed, Special Cases of Average Speed, Relative Speed, Cases of relative speed Circular motion, Applications of STD. | 03 |
| 2. | **Trains** | 02 |

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| | | |
|---|---|---|
| | Stationary Object with Negligible length, Stationary Object with considerable length, moving object with negligible length, moving object with considerable length, Including-Excluding Stoppages. | |
| 3. | **Boat & Streams**<br>Upstream case, Downstream case, Perpendicular movement. | 02 |
| 4. | **Races**<br>Head Start, Dead heat, defeat, 3man participating in race, ratio related examples. | 02 |
| 5. | **Permutation & Combination**<br>Difference between P & C, Theorems of Permutation Theorems of Combination, Counting numbers of squares & rectangles, Triangle. | 02 |
| 6. | **Probability**<br>Introduction, Range of Probability, Sum & Product Rule, Coins, Dice, Cards, Bags & Balls. | 02 |
| 7. | **Geometry**<br>Triangles, Quadrilaterals, Circles, Polygons. | 02 |
| 8. | **Mensuration**<br>Cube, Cuboid, Cylinder, Cone Sphere, Prism. | 02 |
| 9. | **Clock**<br>Basic, Time lag constant, Standard time of coincidence, Various concepts of hour and minute hand, Questions on strikes of clock, find time in the mirror, Questions based on faulty clock, Time gains or loss. | 02 |
| 10. | **Calendar**<br>Leap year, odd day concept, Month code, century codes, Same Calendar concept, Finding day or date (Box method). | 02 |
| 11. | **Seating Arrangement**<br>Type of arrangements, Types of information, Data extraction, Linear-Non-Linear movement, Advance movement. | 02 |
| 12. | **Analytical Reasoning I**<br>Figure Counting, Pattern Completion / Figure Matrix, Embedded Figures / Hidden Figures. | 02 |

| | | |
|---|---|---|
| 13. | **Analytical Reasoning II**<br>Water images, Mirror Images, Cubes and Dice, Paper Folding and Cutting. | 03 |
| 14. | **Statements & Conclusion**<br>Understanding the Premise, Identifying Logical Deductions, Cause and Effect. | 02 |
| | **Total Hrs.** | 30 |

**References -**

**Reference Books:**


- R. S. Aggarwal, "Quantitative Aptitude", S Chand Publishing, New Delhi.
- R. S. Aggarwal, "Logical Reasoning", S Chand Publishing, New Delhi.
- Arun Sharma, "Quantitative Aptitude", McGraw Hill Publishing, New Delhi.
- Arun Sharma, "Logical Reasoning", McGraw Hill Publishing, New Delhi.


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