# OPEN ELECTIVE

| Branch Offering the course | Course Code | Course Name | Branches Eligible to take the course |
|---|---|---|---|
| EC | EC0U41B | Biomedical Instrumentation | CE, ME CS, EE (Eligibility depends on if a similar course is not studied) |
| | EC0U41D | IoT and Applications | CE, ME CS, EE (Eligibility depends on if a similar course is not studied) |
| | EC0U41E | Entertainment Electronics | CE, ME CS, EE (Eligibility depends on if a similar course is not studied) |
| CSE | CS0U41A | Introduction to Mobile Computing | CE, ME ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | CS0U41B | Introduction to Deep Learning | CE, ME ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | CS0U41C | Computer Graphics | CE, ME ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | CS0U41D | Python for Engineers | CE, ME ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | CS0U41E | Object Oriented Concepts | CE, ME ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | CS0U41F | Introduction to AI and ML | CE, ME ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| MED | ME0U41C | Automotive Technology | CE, CS, ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | ME0U41D | Renewable Energy Engineering | CE, CS, ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | ME0U41E | Quality Engineering and Management | CE, CS, ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| CED | CE0U41A | Introduction to Envirinmnetal Impact assessment | ME, CS, ECE, EE,EL (Eligibility depends on if a similar course is not studied) |
| | CE0U41E | Environmental Health and Safety | |
| EED | EL0U41A | Electrical Drives & Control for Automation | ME, CS, ECE, CE (Eligibility depends on if a similar course is not studied) |
| | EL0U41E | Introduction to Flight Dynamics & Control | |
| | EE0U41Z | Architectural Lighting Design & Control | |
| | EE0U41Y | Electric Vehicles | |
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| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| EC0U41B | BIOMEDICAL INSTRUMENTATION | OEC | 3 | 0 | 0 | 3 | 2020 |

## i) COURSE OVERVIEW

This course aims to give a brief introduction to human physiology and various instrumentations system used for measurement and analysis of physiological parameters.

## ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

| Course Outcomes | Description | Level |
|---|---|---|
| CO 1 | Explain the human anatomy and physiological signal Measurements. | Understand |
| CO 2 | Illustrate various techniques used for measurement of Blood flow, blood pressure, and respiration rate and body temperature. | Understand |
| CO 3 | Explain the recording of ECG, EEG, EMG and ERG signals. | Understand |
| CO 4 | Summarize the concept of assisting and therapeutic devices. | Understand |
| CO 5 | Describe the advances in medical imaging techniques. | Understand |

## iii) SYLLABUS

**Introduction to human physiological system**

Physiological systems of the body (brief discussion on Heart and cardio vascular system, Anatomy of nervous system, Physiology of respiratory systems) problems encountered in biomedical measurements. Sources of bioelectric potentials – resting and action potentials - propagation of action potentials – bio electric potentials example (ECG, EEG, EMG, ERG, EOG, EGG etc.)

**Bio potential electrodes and ECG**

Bio potential electrodes – theory – microelectrodes – skin surface electrodes – needle electrodes – biochemical transducers –transducers for biomedical applications. Instrumentation for clinical laboratory: Bio Potential amplifiers instrumentation amplifiers, isolation amplifiers, chopper amplifier Electro conduction system of the heart. Electro cardiograph –electrodes and leads – Einthoven triangle, ECG read out devices, ECG machine – block diagram.

**Measurement of blood pressure, blood flow and heart sound**

Measurement of blood pressure – direct and indirect measurement– oscillometric measurement – ultrasonic method, measurement of blood flow and cardiac output, plethysmography –photo electric and impedance plethysmographs. Measurement of heart sounds –phonocardiography.

**Measurement of EEG, EMG and Respiratory Parameters**

Electro encephalogram –neuronal communication – EEG measurement, recording and analysis. Muscle response– Electromyogram (EMG) – Nerve Conduction velocity measurements- Electromyogram Measurements. Respiratory parameters – Spiro meter, pneumograph.

**Therapeutic Aid**
Cardiac pacemakers – internal and external pacemakers, defibrillators. Ventilators, heart lung machine, haemodialysis, lithotripsy, infant incubators

**Advances in Radiological Imaging**
X-rays- principles of generation, uses of X-rays- diagnostic still picture, fluoroscopy, angiography, endoscopy, and diathermy. Basic principle of computed tomography, magnetic resonance imaging system and nuclear medicine system – radiation therapy. Ultrasonic imaging system – introduction and basic principle.

**Electrical safety**
Electrical safety– physiological effects of electric current –shock hazards from electrical equipment –method of accident prevention, introduction to tele-medicine

**iv) (a) TEXT BOOKS**

1) J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons

2) L. Cromwell, F. J. Weibell and L. A. Pfeiffer, Biomedical Instrumentation Measurements, Pearson education, Delhi, 1990.

3) R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill.

4) J. J. Carr and J. M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education.

**(b) REFERENCES**

1) John Enderele , Susan Blanchard, Joseph Bronzino, Introduction to Biomedical Engg, Academic Press

2) Welkovitz, Biomedical Instruments, Theory and Design, Elselvier

3) Jerry L Prince, Jonathan M Links, Medical Imaging Signals & Systems, Pearson Education

**v) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | **Introduction to human physiological system**<br>Physiological systems of the body (brief discussion on Heart and cardio vascular system, Anatomy of nervous system, Physiology of respiratory systems) problems encountered in biomedical measurements. Sources of bioelectric potentials – resting and action potentials -propagation of action potentials – bio electric potentials example (ECG, EEG, EMG, ERG, EOG, EGG etc.) | 9 |
| II | **Bio potential electrodes and ECG**<br>Bio potential electrodes – theory – microelectrodes – skin surface electrodes – needle electrodes – biochemical transducers – transducers for biomedical applications. Instrumentation for clinical laboratory: Bio Potential amplifiers instrumentation amplifiers, isolation amplifiers, chopper amplifier Electro conduction system of | 9 |

| | | |
|---|---|---|
| | the heart. Electro cardiograph –electrodes and leads – Einthoven triangle, ECG read out devices, ECG machine – block diagram. | |
| **III** | **Measurement of blood pressure, blood flow and heart sound**<br>Measurement of blood pressure – direct and indirect measurement– oscillometric measurement – ultrasonic method, measurement of blood flow and cardiac output, plethysmography –photo electric and impedance plethysmographs. Measurement of heart sounds – phonocardiography. | **9** |
| **IV** | **Measurement of EEG, EMG and Respiratory Parameters**<br>Electro encephalogram –neuronal communication – EEG measurement, recording and analysis. Muscle response– Electromyogram (EMG) – Nerve Conduction velocity measurements- Electromyogram Measurements. Respiratory parameters – Spiro meter, pneumograph.<br>**Therapeutic Aid**<br>Cardiac pacemakers – internal and external pacemakers, defibrillators. Ventilators, heart lung machine, haemodialysis, lithotripsy, infant incubators | **9** |
| **V** | **Advances in Radiological Imaging**<br>X-rays- principles of generation, uses of X-rays- diagnostic still picture, fluoroscopy, angiography, endoscopy, and diathermy. Basic principle of computed tomography, magnetic resonance imaging system and nuclear medicine system – radiation therapy. Ultrasonic imaging system – introduction and basic principle.<br>**Electrical safety**<br>Electrical safety– physiological effects of electric current –shock hazards from electrical equipment –method of accident prevention, introduction to tele-medicine | **9** |
| | **Total hours** | **45** |

**vi) ASSESSMENT PATTERN**

**Mark distribution**

| Total Marks | Continuous Internal Evaluation Marks | End Semester Evaluation Marks | End Semester Examination Duration |
|---|---|---|---|
| **150** | **50** | **100** | **3 Hours** |

**Continuous Internal Evaluation Pattern:**

| | |
|---|---|
| **Attendance** | **10 Marks** |
| **Continuous Assessment Tests (2 numbers)** | **25 Marks** |
| **Assignment/Quiz/Course project** | **15 Marks** |

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contain10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| EC0U41D | IOT AND APPLICATIONS | OEC | 2 | 1 | 0 | 3 | 2020 |

**i) PREREQUISITE:** Students should have a basic knowledge in Embedded systems.

**ii) COURSE OVERVIEW**

This course aims to develop skills in IoT system development and to apply the same in real life applications

**iii) COURSE OUTCOMES**

After the completion of the course the student will be able to:

| Course Outcomes | Description | Level |
|---|---|---|
| CO 1 | Understand the IoT fundamentals and architecture modeling | Understand |
| CO 2 | Understand the smart things in IoT and functional blocks | Understand |
| CO 3 | To understand the communication networks and protocols used in IoT. | Understand |
| CO 4 | To understand the cloud resources, data analysis and applications. | Apply |
| CO 5 | To apply the IoT processes in embedded applications. | Apply |

**iv) SYLLABUS**

Introduction to IoT- Definitions and Characteristics, Architectural View, Logical Design of IoT- Functional blocks, Communication models, IoT Levels & Deployment Templates.

IoT and M2M- M2M, Difference between IoT and M2M, SDN and NFV for IoT, Smart Objects: Sensors, Actuators, and Smart Objects, Wireless Sensor Networks, Communication Protocols for Wireless Sensor Networks- Connecting Smart Objects

Unified Data Standards –Protocols –IEEE 802.15.4 -The Physical Layer, The Media-Access Control Layer, Uses of 802.15.4, Modbus, ZigBee-Zigbee Architecture- LoRaWAN - Standardization and Alliances, Physical Layer, MAC Layer, Topology, LTE-M, NB-IoT-Network layer. IP-based protocols -6LoWPAN and RPL

Data Collection, storage and computing Using a Cloud Platform-Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing, Cloud Deployment Models, Cloud based platforms. IoT Physical Devices & Endpoints-IoT Device –Raspberry-Pi -Board-Linux on Raspberry-Pi-Raspberry-Pi Interfaces. Raspberry Pi interfacing and Programming.

IoT privacy, security and vulnerabilities solutions, vulnerabilities, security requirements, threat analysis, security tomography, layered attacker model, Identity management. Smart and Connected Cities-An IoT Strategy for Smarter Cities, Smart City Security Architecture - Smart City Use-Case Examples

**v) (a) TEXT BOOKS**


1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on- Approach)", 1st Edition, VPT, 2014 (Module1,2,4)
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017. (Module2,3,5)
3. Rajkamal, "Internet of Things: Architecture and Design Principles", McGraw Hill (India) Private Limited.
4. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN.


**(b) REFERENCES**


1. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things –Key applications and Protocols", Wiley, 2012 (Module 3)
2. Al-Fuqaha et al. Internet of things: A survey on enabling technologies, protocols, and applications. IEEE Communications Surveys & Tutorials (2015), pp. 2347- 2376.
3. The Internet of Things (The MIT Press Essential Knowledge series) Paperback – March 20, 2015 by Samuel Greengard
4. The Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Ovidu Vermesan and Peter Friess, River Publishers.
5. Internet of Things - From Research and Innovation to Market Deployment-RIVER PUBLISHERS, PETER FRIESS, OVIDIU VERMESAN (Editors)
6. Internet of Things Security and Data Protection, Sébastien Ziegler, Springer International Publishing 2019.


**vi) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | Introduction to IoT technology: Definitions and Characteristics of IoT, IoT Architectural View, Physical Design of IOT, Logical Design of IoT- IoT Functional blocks, IoT communication models, IoT Enabling Technologies, IoT Levels & Deployment Templates. | 9 |
| II | IoT and M2M- M2M, Difference between IoT and M2M, SDN and NFV for IoT, Smart Objects: The "Things" in IoT: Sensors, Actuators, and Smart Objects, Sensor Networks- Wireless Sensor Networks (WSNs), Communication Protocols for Wireless Sensor Networks- Connecting Smart Objects- Communication Criteria. | 9 |
| III | Unified Data Standards –Protocols –IEEE 802.15.4 -The Physical Layer, The Media-Access Control Layer, Uses of 802.15.4 ,The Future of 802.15.4: 802.15.4e and 802.15.4g–Modbus– ZigBee-Zigbee Architecture- LoRaWAN -Standardization and Alliances, Physical Layer, MAC Layer, Topology, LTE-M, NB-IoT-Network layer –The next generation: IP-based protocols - 6LoWPAN and RPL, Overview of the 6LoWPAN Adaptation Layer. | 9 |
| IV | Data Collection, storage and computing Using a Cloud Platform-Introduction, Cloud Computing Paradigm for Data Collection, Storage and Computing-Cloud Computing Paradigm, Cloud Deployment Models-Everything as a Service and Cloud Service Models-SaaS, | 9 |

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|---|---|---|
| | PaaS, IaaS, DaaS. Cloud based platforms-XIVELY, NIMBITS.<br>IoT Physical Devices & Endpoints-IoT Device-Building blocks – Raspberry-Pi -Board-Linux on Raspberry-Pi-Raspberry-Pi Interfaces (serial, SPI, I2C). Raspberry Pi interfacing and programming examples using python (LED, switch, sensor, serial, SPI, I2C devices).<br>Controlling GPIO outputs and displaying sensor readings using web interface/cloud. (Python programming is required only for assignments and projects and not for examinations. Other end nodes and platforms can also be used). | |
| **V** | IoT privacy, security and vulnerabilities solutions, vulnerabilities, security requirements, threat analysis, security tomography, layered attacker model, Identity management, access control, secure message communication.<br>Smart and Connected Cities-An IoT Strategy for Smarter Cities-Vertical IoT Needs for Smarter Cities, Global vs. Siloed Strategies-Smart City IoT Architecture-Street Layer, City Layer, Data Center Layer, Services Layer- Smart City Security Architecture.<br>Smart City Use-Case Examples – Street lighting, smart parking, smart traffic and air pollution monitoring | **9** |
| | **Total hours** | **45** |

**vii) ASSESSMENT PATTERN**

**Mark distribution**

| Total Marks | Continuous Internal Evaluation Marks | End Semester Evaluation Marks | End Semester Examination Duration |
|---|---|---|---|
| **150** | **50** | **100** | **3 Hours** |

**Continuous Internal Evaluation Pattern:**

| | |
|---|---|
| **Attendance** | **10 Marks** |
| **Continuous Assessment Tests (2 numbers)** | **25 Marks** |
| **Assignment/Quiz/Course project** | **15 Marks** |

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| EC0U41E | ENTERTAINMENT ELECTRONICS | OEC | 2 | 1 | 0 | 3 | 2020 |

## i) COURSE OVERVIEW

This course introduces students to various industry standards, algorithms and technologies used to carry out digital audio and video broadcasting in the infotainment industry.

## ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

| Course Outcomes | Description | Level |
|---|---|---|
| CO 1 | Describe packetized streaming of digital media | Understand |
| CO 2 | Discuss the critical aspects of DVB and DAB standards used for media broadcasting | Understand |
| CO 3 | Realize video coding/compression algorithms to produce high-definition video in MPEG-4 standard | Apply |
| CO 4 | Discuss the use of modern display technologies for video reproduction | Understand |

## iii) SYLLABUS

Brief Review of Analog Television: Scanning, Horizontal and Vertical Synchronization, Color information, Transmission methods. NTSC and PAL standards. Digital media streaming: Packetized elementary stream of audio- video data, MPEG data stream, MPEG-2 transport stream packet, Accessing a program, scrambled programs, program synchronization. PSI, Additional (Network information and service description) information in data streams for set-top boxes.

Digital Video Broadcasting (DVB): Satellite TV broadcasting – DVB-S Parameters, DVB-S Modulator, DVB-S set-top box, DVB-S2. Cable TV broadcasting – DVB-C Standard, DVB-C Modulator, DVB- C set-top box. Terrestrial TV broadcasting – DVB-T Standard, DVB-T Modulator, DVB-T Carriers and System Parameters, DVB-T receiver. Broadcasting for Handheld devices – DVB-H Standard. DVB tele-text, DVB subtitling system.

Digital Audio Broadcasting (DAB): Comparison of DAB with DVB. Physical layer of DAB. DAB Modulator, DAB Data Structure, DAB single frequency networks, Data broadcasting using DAB. Digital Radio Mondiale (DRM): Transmitter and receiver, Data rates.

High Definition Video and Audio: Pixel resolution, Comparison with Standard Definition TV, Review of Discrete Cosine Transforms (DCT), Video Compression - Quantization levels, Horizontal/Vertical blanking interval, Vertical Color resolution, DPCM of moving pictures, DCT, Run-length coding. MPEG-4 Video coding. Psycho-acoustic model, Principle of audio coding, Sub-band coding in MPEG layer 1 and 2, MPEG Layer 3 and Dolby Digital, Multichannel sound.

Display Technology: Block diagram of video reproduction system in a TV, Cathode Ray tubes, Basic principle of Plasma displays, LC displays, Light-emitting diode displays, Field emission displays, Organic light emitting device displays. Television of future: Holographic TV, Virtual Reality, Augmented Reality.

**iv) a) TEXT BOOKS**


1) W. Fischer, Digital Video and Audio Broadcasting Technology: A Practical Engineering Guide (Signals and Communication Technology), Springer, 2020
2) Lars-Ingemar Lundström, Understanding Digital Television: An Introduction to DVB Systems with Satellite, Cable, Broadband and Terrestrial TV, Focal Press, Elsevier, 2006.
3) K F Ibrahim, Newnes Guide to Televeision and Video Technology, Newnes, 2007.
4) Jiun-Haw Lee, David N. Liu, Shin-Tson Wu, Introduction to Flat Panel Displays, Wiley, 2008.


**b) REFERENCES**


1) C. Poynton, "Digital Video and HD Algorithms and Interfaces,"Morgan Kaufmann, 2012.
2) Wolfgang Hoeg, Thomas Lauterbach, Digital audio broadcasting: principles and applications of DAB, DAB+ and DMB, Wiley, 2009.
3) John Watkinson, Introduction to Digital Audio, Focal Press, 1994.
4) John Watkinson, Art of Digital Video, Focal Press, 2008.
5) John Watkinson, Introduction to Digital Video, Focal Press, 2001.


**v) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | Analog Television, Scanning, Horizontal and Vertical Synchronization, Colour information, NTSC and PAL standards. Analog TV Transmission<br><br>Packetized elementary stream. MPEG data stream, MPEG-2 transport stream packet. Accessing a program, scrambled programs, program synchronization. Program Specific Information. Additional (Network information and service description) information in data streams | 9 |
| II | Introduction to DVB, DVB-S Parameters, DVB-S Modulator, DVB-S set-top box, DVB-S2. DVB-C Standard, DVB-C Modulator, DVB-C set-top box. DVB-T Standard, DVB-T Modulator, DVB-T Carriers and System Parameters, DVB-T receiver. Broadcasting for Handheld devices – DVB-H Standard. DVB teletext, DVB subtitling system. | 9 |

| | | |
|---|---|---|
| **III** | Introduction to DAB, Comparison of DAB with DVB. Physical layer of DAB. DAB Modulator, DAB Data Structure, DAB single frequency networks, Data broadcasting using DAB.<br>Digital Radio Mondiale (DRM): Transmitter and receiver, Data<br>rates. | **8** |
| **IV** | HDTV versus SDTV, Pixel resolution, Review of Discrete Cosine Transforms (DCT)<br>Video Compression - Quantization levels, Horizontal/Vertical blanking interval, Vertical Colour resolution, DPCM of moving pictures, DCT, Run-length and Huffman coding. MPEG-4.<br>Psychoacoustic model, Principle of audio coding. Subband coding in MPEG layer 1 and 2. MPEG Layer 3 and Dolby Digital, Multichannel sound | **10** |
| **V** | Block diagram of video reproduction system in a TV<br>Cathode Ray tubes, Basic principle of Plasma displays, LC displays, Light-emitting diode displays, Field emission displays, Organic light emitting device displays.<br>Holographic TV, Virtual Reality, Augmented Reality. | **9** |
| | **Total hours** | **45** |

## vi) ASSESSMENT PATTERN

**Mark distribution**

| Total Marks | Continuous Internal Evaluation Marks | End Semester Evaluation Marks | End Semester Examination Duration |
|---|---|---|---|
| **150** | **50** | **100** | **3 Hours** |

**Continuous Internal Evaluation Pattern:**

| | |
|---|---|
| **Attendance** | **10 Marks** |
| **Continuous Assessment Tests (2 numbers)** | **25 Marks** |
| **Assignment/Quiz/Course project/Simulation Assignment** | **15 Marks** |

**Simulation Assignments (optional)**

1. Realise live streaming of audio and video data using Python/MATLAB-Simulink or other platforms.
2. Realise a basic video compression scheme from basic principles studied from this course using Python/MATLAB. Obtain the performance parameters before and after comparison.
3. Simulate a DAB transmitter and receiver system using MATLAB/Simulink and study its performance under Gaussian noise.

**End Semester Examination Pattern:**

There will be two parts; Part A and Part B. Part A contain10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| ME0U41C | AUTOMOTIVE TECHNOLOGY | OEC | 2 | 1 | 0 | 3 | 2020 |

i) **PRE-REQUISITE:** ES0U10C Basics of Mechanical Engineering

ii) **COURSE OVERVIEW:**

The objective of this course is

- To know the anatomy of automobile in general
- To understand the working of different automotive systems and subsystems
- To update the latest developments in automobiles

iii) **COURSE OUTCOMES:**

After the completion of the course, the student will be able to:

| CO No | Course Outcomes | Level |
|---|---|---|
| CO1 | Explain different automotive systems and subsystems | Understand |
| CO2 | Illustrate the working of transmission, suspension, steering and braking systems of an automobile. | Understand |
| CO3 | Summarize the basic technology in electric vehicles. | Understand |
| CO4 | Explain the various safety, security and comfort systems in automotive technology. | Understand |

iv) **SYLLABUS:**

Automobile system layout- Engine and its components, SI and CI engine, working principle, Fuel supply and injection system-comparison, multiport fuel injection (MPFI) and common rail direct injection (CRDI) systems. Ignition system, Engine emission and standards. Friction clutch: Principle, dry friction clutch- Pull type diaphragm clutch, multiple diaphragm clutch, multi-plate hydraulically operated automatic transmission clutch, semi-centrifugal clutch, Suspension system: - Types of suspension springs, suspension geometry and terminology, types of suspension systems, independent suspension. Antiroll bar, Hydrogen suspension, Brakes: Principle of brake, classification of brakes-mechanical and hydraulic brakes- Drum and Disc brakes, properties of friction lining and pad materials, Anti-Lock Braking system (ABS), principle of operation and types of ABS, Electric Vehicle Technology (EVT): EV Architecture, types of batteries, battery parameters, super capacitors. Fuel cells and its efficiency. Safety-Active and passive safety, air bags, seat belt tightening system, forward collision warning system, child lock

advanced safety systems. Comfort system –Automotive air-conditioning, aerodynamics lift and drag reduction, adaptive cruise control

v **a) TEXTBOOKS**


1) Heinz Heisler, Vehicle and engine technology, Butterworth-Heinemann, 2nd edition,199

2) R.B. Gupta., Auto design , Satya Prakashan Publishers, New Delhi, 2016 .

3) James Larminie and John Lowry, Electric vehicle technology explained, Wileypublications, 2nd edition, 2015.

4) Kirpal Singh, Automobile Engineering Vol.1 & Vol.2, Standard Publishers, 13th edition,2020.


**b) REFERENCES**


1) V.A.W. Hillier, Fundamentals of modern vehicle technology, Butterworth-Heinemann, 2ndedition,1998.

2) Tom Denton, Electric and Hybrid Vehicles, Routledge Publishers, 2nd edition, 2020.

3) Ljubo Vlacic, Michel Parent and Fumio Harashima, Intelligent vehicle technologies, Butterworth-Heinemann publications, Oxford 2001.

4) ShimoKim and Rakesh Shresta, Automotive Cyber Security: Introduction Challenges and Standardization, Springer, Singapore, 1st edition. 2020.


**vi)**

**COURSE PLAN:**

| Module | Contents | No. of hours |
|---|---|---|
| I | Engine and its components- IC engines, piston, rings, pin, flywheel, connecting rod. SI and CI engine, working principle, Fuel supply and injection system-comparison, MPFI and CRDI systems, Ignition system, Engine emission and standards, Super charging systems | 9 |
| II | **Clutch and transmission:** Principle of dry friction clutches- Single plate clutch, Multi plate hydraulically operated automatic transmission clutch. Semi centrifugal clutch, fully automatic centrifugal clutch, Integral single plate diaphragm clutch, Electromagnetic clutch, Clutch friction materials, wet clutches, fluid friction coupling. Need of gear box, power to weight ratio, speed operating range, Epicyclic gear box, Torque convertor, Over drives, Automated manual transmission. | 9 |

| | | |
|---|---|---|
| **III** | **Suspension and brake:** Suspension system: - Types of suspension springs, suspension geometry and terminology. Types of suspension systems ,independent suspension. Antiroll bar, Hydrogen suspension, hydro pneumatic suspension. Suspension roll center and body roll. Brakes: Principle of brake, classification of brakes, mechanical and hydraulic brakes. Drum and Disc brakes, properties of friction lining and pad materials Anti-Lock Braking system (ABS), principle of operation and typesof ABS. | **9** |
| **IV** | **Steering and Electric vehicle technology:** Ackermann steering mechanism, over steer and under steer. Steering geometry -slip angle, camber, king pin inclination, caster, toe-in and toe-out. Steering gear box, Types of steering gear box, need of power assisted steering. EV Architecture, types of batteries, battery parameters, super capacitors. Tesla , Maglev Train. | **9** |
| **V** | **Safety, control and security in automotive technology:** Safety-Active and passive safety, air bags, seat belt tightening system, Forward collision warning system, child lock antilock braking system Comfort system - Automotive air-conditioning, aerodynamics lift and drag reduction Adaptive cruise control, tilt-able steering column, power window and advanced comfort system Anti-theft technology-mechanical, electromechanical and electronic immobilizers. Alarm system and remote keyless entry. | **9** |
| | **Total hours** | **45** |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| ME0U41D | Renewable Energy Engineering | OEC | 2 | 1 | 0 | 3 | 2020 |

i) **PRE-REQUISITE: NIL**

ii) **COURSE OVERVIEW:**

The course is intended to give knowledge of various renewable energy sources, systems and applications and the need in the present context. Students will be able to compare different renewable energy techniques and choose the most appropriate based on local conditions. To equip students in working with projects and to take up research work in connected areas.

iii) **COURSE OUTCOMES:**

After the completion of the course, the student will be able to:

| CO No | Course Outcomes | Level |
|---|---|---|
| CO1 | Explain renewable energy sources and evaluate the implication of renewable energy to predict solar radiation at a location | Understand |
| CO2 | Explain the working and characteristics of solar energy collectors, and solar cell. | Understand |
| CO3 | Explain the different types of wind power machines and control strategies of wind turbines | Understand |
| CO4 | Explain the ocean energy and conversion devices and different Geothermal sources | Understand |
| CO5 | Explain biomass energy conversion devices and calculate the net present value and payback period | Understand |

iv) **SYLLABUS:**

**The Energy Scenario**- Commercial energy sources -World's production and reserves- India' Production and reserves, Energy Alternatives, Need for alternatives. **Solar Energy collectors**- Solar thermal collectors -Flat plate collectors –Solar concentrators. **Wind Energy**- classification of wind turbines and power performance curve, Energy in wind, calculation of energy content, Power coefficients, Betz limit theory, tip speed ratio, solidity of turbine' power control strategies. **Ocean Energy** – Devices for Wave Energy conversion, Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation. **Geothermal energy**- Introduction, hot dry rock resources, magma resources, vapor and liquid dominated systems, binary cycle, advantages and disadvantages **Bio Mass Energy**- Biomass conversion technologies –Bio Gasification, Bio ethanol, Bio Diesel , Biogas production from waste biomass. **Economic Analysis** – Initial and annual cost, basic definitions, present worth calculations.

v **a) TEXTBOOKS**

1) S P Sukhatme , J K Nayak, Solar Energy: Principles of Thermal Collection and

Storage, Mc Graw Hill ,2015

2) Tiwari G N, Ghosal M K ,Fundamentals of renewable energy sources, Alpha Science International Ltd.,2007

3) Jefferson W Tester et.a., Sustainable Energy Choosing among options,PHI,2006

**b) REFERENCES**

1) D.P. Kothari Renewable energy resources and emerging technologies, Prentice Hall of India Pvt. Ltd,2011

2) Mehmet KanoğluYunus A. Çengel John M. Cimbala , Fundamentals and Applications of Renewable Energy, Mc Graw Hill ,2019

3) Roland Wengenmayr, Thomas Buhrke, 'Renewable Energy: Sustainable energy concepts for the future, Wiley – VCH, 2012

**vi)**

**COURSE PLAN:**

| Module | Contents | No. of hours |
|---|---|---|
| I | The Energy Scenario- Commercial energy sources -World's production and reserves- India' Production and reserves, Energy Alternatives, Need for alternatives –solar option- nuclear options Principles of solar radiation : Solar radiation outside the earth's atmosphere and at the earth's surface , Solar Constant, Basic Sun-Earth Angles, Instruments for measuring solar radiation and sunshine , Solar radiation data | 9 |
| II | Solar Energy collectors: Solar thermal collectors -Flat plate collectors –Solar concentrators (parabolic trough, parabolic dish, Central Tower Collector)–Solar Air Heaters.<br>Solar thermal electric power generation -Thermal Energy storage, sensible heat storage, latent heat storage , Thermo chemical storage , photovoltaic system for power generation , Solar pond -Solar Cells- Types of solar cells , principle of working and performance characteristics, Production process- Block diagram only | 9 |
| III | Wind Energy- classification of wind turbines and power performance curve, Energy in wind, calculation of energy content, Power coefficients, Betz limit theory, tip speed ratio, solidity of turbine' power control strategies, Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS. | 9 |
| IV | Ocean Energy – Devices for Wave Energy conversion, Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Geothermal energy: Introduction, hot dry rock resources, magma resources, vapor and liquid dominated systems, binary cycle, advantages and disadvantages | 9 |

| | | |
|---|---|---|
| V | Bio Mass Energy- Biomass conversion technologies –Bio Gasification, Bio ethanol, Bio Diesel , Biogas production from waste biomass, factors affecting biogas generation Bio Gas -KVIC and Janata model ,Hydrogen Energy – various routes for production of Hydrogen energy.<br>Economic Analysis – Initial and annual cost, basic definitions, present worth calculations, repayment of loan in equal and annual installments, annual savings, cumulative saving and cycle cost, economic analysis of add on solar system, payback period(derivation) | 9 |
| | **Total hours** | **45** |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| ME0U41E | QUALITY ENGINEERING AND MANAGEMENT | OEC | 2 | 1 | 0 | 3 | 2020 |

i) **PRE-REQUISITE:** NIL

ii) **COURSE OVERVIEW:**

Objective of the course is to to facilitate the students to understand the concept and culture of total quality management

iii) **COURSE OUTCOMES:**

After the completion of the course, the student will be able to:

| CO No | Course Outcomes | Level |
|---|---|---|
| CO1 | Explain the important terms for quality management in organisations. | Understand |
| CO2 | Explain the complete theoretical and practical contributions of Quality Gurus. | Understand |
| CO3 | Explain the knowledge of the underlying principles of strategic quality management | Understand |
| CO4 | Explain various human dimensions of TQM | Understand |
| CO5 | Apply different tools and techniques in TQM | Apply |
| CO6 | Apply different statistical quality control techniques | Apply |

iv) **SYLLABUS:**

**Quality Engineering** - Quality, quality planning, quality control, quality assurance, quality management, Total Quality Management (TQM) - Barriers to TQM Deming approach to TQM – Juran's quality trilogy- Crosby's fourteen steps for quality improvement

**Strategic Quality Management:** Cost of Quality- Customer satisfaction- Quality Function Deployment (QFD)- Concepts of 5S, Six Sigma, Kaizen

**Human dimensions of TQM** – Top management commitment- Leadership for TQM- Employee involvement, role of the quality director- Quality System: ISO 9000 family of standards

**Quality control and Inspection**- Destructive and non-destructive testing methods- process

capability- Statistical quality control –Acceptance sampling- Reliability-types and causes of failures- Bath tub curve.-System reliability- life testing

**Activities And Techniques in TQM Projects :** Affinity diagram -brainstorming - cause and effect analysis - process flow chart – check sheets- Scatter diagram - Pareto chart- Histogram and fundamentals of statistics - Taguchi's robust design- Total Productive maintenance- Failure Mode and Effect Analysis - Quality auditing- types

and benefits.

v **a) TEXTBOOKS**

1) Besterfield Dale H. , Besterfield Carol, Besterfield Glen H., Besterfield Mary, Urdhwareshe Hemant, Urdhwareshe Rashmi, "Total Quality Management (TQM) 5e", Pearson Education, 2018.

2) Juran J M and Gryna, F M, "Quality Planning and Analysis - From Product Development through Use", Tata McGraw Hill Publishing Limited, New Delhi, Third Edition, 2004.

**b) REFERENCES**

1) Subburaj Ramasamy, "Total Quality Management", McGraw Hill Education,, 2017.

2) Dr. K.C. Arora, "Total Quality Management", S K Kataria and Sons, 2013.

vi)

**COURSE PLAN:**

| Module | Contents | No. of hours |
|---|---|---|
| I | **Quality Engineering** - Quality planning, quality control, quality assurance, quality management, Total Quality Management (TQM)- the TQM axioms - consequences of total quality- Barriers to TQM Deming approach to TQM – Juran's quality trilogy- Crosby's fourteen steps for quality improvement | 8 |

| | | |
|---|---|---|
| II | **Strategic Quality Management**: Cost of Quality- Customer satisfaction- Quality Function Deployment (QFD)- Integrating quality into strategic management - quality and the management cycle- obstacles to achieving successful strategic quality management- supplier selection- Concepts of 5S, Six Sigma, Lean, Kaizen | 9 |
| III | **Human dimensions of TQM** – Top management commitment- Leadership for TQM- Change management- resources for quality activities - training for quality –Employee involvement, motivation empowerment- teamwork- self managing teams - role of the quality director | 10 |
| IV | **Activities And Techniques in TQM Projects** : Affinity diagram - brainstorming - cause and effect analysis - process flow chart – check sheets- Scatter diagram - Pareto chart- Histogram and fundamentals of statistics - Control charts for improving process capability- Taguchi's robust design- Total Productive maintenance- Failure Mode and Effect Analysis | 9 |
| V | **Quality System**: ISO 9000 family of standards- ISO 9001:2000 model, quality management system- management responsibility- resource management- product realisation- measurement analysis and improvements- ISO 14000 family of standards- Quality auditing- types and benefits. | 9 |
| | **Total hours** | 45 |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CE0U41A | INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT | OEC | 3 | 0 | 0 | 3 | 2020 |

**i) PRE-REQUISITE:** Nil

**ii) COURSE OVERVIEW:**

The goal of this course is to introduce the methodologies for identifying, predicting, evaluating and mitigating the impacts on the environment due to any developmental project or activities. The course also creates awareness on the environmental clearance procedures in India and preparation of an impact assessment report.

**iii) COURSE OUTCOMES**

After the completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO 1 | Explain the need for conducting environmental impact assessment and environmental audit | Understand |
| CO 2 | Outline the environmental legislations and EIA clearance procedure in India | Understand |
| CO 3 | Apply various methodologies for assessing the environmental impacts of any developmental activity | Apply |
| CO 4 | Identify the various impacts through different case studies on EIA | Apply |

**iv) SYLLABUS**

Definition, Need for EIA, Evolution of EIA-Environmental legislations in India-Environmental clearance process in India-Types of EIA-EIA methodologies-Environmental Management Plan (EMP)- Environment Audit- ISO 14001 standards- EIA case studies

**v) (a) TEXT BOOKS**

1) Canter, L. W., *Environmental Impact Assessment*, McGraw Hill Inc., NewDelhi,1996.
2) Anjaneyulu, Y., *Environmental Impact Assessment Methodologies*, B. S. Publications, Hyderabad, 2020.
3) Barthwal, R. R., *Environmental Impact Assessment,* New Age International Publishers, 2012.

4) Shukla, S. K. and Srivastava, P. R., Concepts *in Environmental Impact Analysis*, Commonwealth Publishers, New Delhi, 2017.

**(b) REFERENCES**

1) Glasson, J. and Therivel, R., *Introduction to Environmental Impact Assessment*, Routledge Publications, Fifth Edition, 2019.
2) Reddy, M. A., *Environmental Impact Assessment* -Theory and Practice, BS Publications, 2017.
3) Lawrence, D. P., *Environmental Impact Assessment (Practical Solutions to Recurrent Problems)*, Wiley International, New Jersey, 2005.
4) Ministry of Environment and Forests, EIA *Notification*, Govt. of India, 2006.

**vi) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | Definition, Need for EIA, Evolution of EIA: Global & Indian scenario - Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution) Act 1981, The Environmental (Protection) Act 1986- Environmental standards for water, air and noise quality- EIA Notification 2006 | 9 |
| II | Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal- Form1-Category of projects- Generic structure of EIA report- Terms of Reference (ToR) -Types of EIA: strategic, regional, sectoral, project level- Rapid EIA and Comprehensive EIA- Initial Environmental Examination (IEE) | 9 |
| III | EIA methodologies: Ad hoc, checklist, matrix, network and overlay- Impact Prediction, Evaluation and Mitigation- Prediction and assessment of the impact on water (surface water and groundwater), air, and noise environment- assessment of ecological impacts and Socio economic Impacts. | 9 |
| IV | Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP- Role of environmental monitoring program Environment Audit: need for audit- audit types and benefits- environmental audit procedure. ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits | 9 |
| V | EIA case studies (Indian)- a highway project, a hydroelectric power plant, an airport project, a quarry mining project and a solid waste management project. | 9 |
| | **Total hours** | **45** |

### vii) MARK DISTRIBUTION

| Total Marks | CIE | ESE | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 hours |

### viii) CONTINUOUS INTERNAL EVALUATION PATTERN

| | | |
|---|---|---|
| Attendance | : | 10 marks |
| Continuous Assessment Test (2 numbers) | : | 25 marks |
| Assignment/Quiz/Course Project | : | 15 marks |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CE0U41E | ENVIRONMENTAL HEALTH AND SAFETY | OEC | 3 | 0 | 0 | 3 | 2020 |

**i) PRE-REQUISITE:** NIL

**ii) COURSE OVERVIEW**

The course is designed to build environmental health literacy among students and encourages them to take safety measures against various environmental hazards. It motivates the students in maintaining and improving the quality of the environment and empower learners to take appropriate actions to reduce the environment pollution

**iii) COURSE OUTCOMES**

After the completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO 1 | Explain the toxicology and occupational health hazards associated with industries | Understand |
| CO 2 | Identify the various chemical and biological hazards that can impact human health. | Apply |
| CO 3 | Identify various measures to ensure safety in construction industry. | Apply |
| CO 4 | Explain the effects of various pollutants on environment and human health | Understand |
| CO 5 | Identify various measures for providing a safe working environment in different types of industries. | Apply |

**iv) SYLLABUS**:

Introduction to Occupational health and Toxicology, Industrial Hygiene, Chemical hazards, Biological hazards, Safety in construction industry, Air pollution, Water Pollution, Waste Management, Safe working environment: Safety inspection. conservation of natural resources.

**v) (a) TEXT BOOKS**

1) Jain, R.K., and Rao, S. S., *Industrial Safety, Health and Environment Management Systems*, Khanna Publishers, New Delhi ,2006.
2) Taylor, B., *Effective Environmental, Health and Safety Management Using the Team Approach*, Culinary and Hospitality Industry Publications Services, 2005.

3) Gallant, B., *The Facility Managers Guide to Environmental Health and Safety* Government Inst. Publ., 2007.

**(b) REFERENCES**

1) Davis, M.L., *Introduction to Environmental Engineering*, Mcgraw Hill Education, (India), 2012
2) Course Manual, *Associate Fellow of Industrial Health (AFIH)*, Government of India, 2019.
3) Slote. L, *Handbook of Occupational Safety and Health*, John Willey and Sons, NewYork, 1987.

**vi) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | Introduction to Occupational Health and Toxicology. Safety at work – Socio – Economic reasons. Introduction to health and safety at various industries. Occupational related diseases- Musculoskeletal disorders, hearing impairment. Occupational related diseases- carcinogens, silicosis, asbestosis, pneumoconiosis. Toxic materials and substances used in work. Exposure limits, toxicological investigation. Industrial Hygiene. Arrangements by organisations to protect the workers. | 9 |
| II | Chemical hazards. Dust, fumes, vapour, fog, gases, Methods of Control. Biological hazards. Classification of Biohazardous agents. Bacterial agents, viral agents, fungal, parasitic agents, infectious diseases. Control of biological agents at workplaces Noise, Noise exposure regulation and control. | 9 |
| III | Safety in Construction industry- Scaffolding and Working platform. Welding and Cutting, Excavation Work, Concreting. Control measures to reduce the risk. Electrical Hazards. Protection against voltage fluctuations. Effects of shock on human body, Radiation Hazards, Types and effects of radiation on human body, Disposal of radioactive waste. | 9 |
| IV | Air Pollution - air pollutants from industries. Effect on human health, animals. Plants and Materials - depletion of ozone layer. Concept of clean coal combustion technology. Water Pollution - water pollutants. Health hazards - effluent quality standards. Waste Management-waste identification. Characterization and classification. Recycling and reuse. | 9 |
| V | Safe working environment in different types of industries- purpose and benefits of safety inspection. First-aid appliances. Shelters, rest | 9 |

| | | |
|---|---|---|
| | rooms and lunch rooms. Use of personal protective equipment. Role of an individual in conservation of natural resources. | |
| | **Total hours** | **45** |

### vii) MARK DISTRIBUTION

| Total Marks | CIE | ESE | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 hours |

### viii) CONTINUOUS INTERNAL EVALUATION PATTERN

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| EE0U33W | ELECTRICAL DRIVES AND CONTROL FOR AUTOMATION | OEC | 3 | 0 | 0 | 3 | 2022 |

**i) PRE-REQUISITE: Nil**

**ii) COURSE OVERVIEW**:

This course is intended to provide the basic concepts of different types of electrical machines and their performance. The course also introduces to the different methods of starting D.C motors and induction motors and the introduction to the controllers for automation

**iii) COURSE OUTCOMES**

After the completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO1 | Choose a drive for a particular application based on power rating. | Understand |
| CO2 | Explain the working of DC motors drives. | Understand |
| CO3 | Explain the working of Induction motors drives. | Understand |
| CO4 | Explain variable speed synchronous and permanent motor drives. | Understand |
| CO5 | Discuss the controllers used for automation. | Understand |

**iii) SYLLABUS**

Block diagram of Electric Drives – Dynamics of motor load system-Steady state stability. Introduction to closed loop control of drives.

DC Motors - principle of operation-emf equation-types of excitations.

DC motor drives- separately excited dc motor drives using controlled rectifiers, single phase and three phase semi converter and fully controlled converter drives, Chopper controlled DC drives.

Three phase induction motors - principle of operation, Induction Motor Drives, Voltage source inverter control - Current source inverter control. Rotor chopper speed control – slip power recovery control schemes.

Synchronous motor drives – Synchronous motor variable speed drives - variable frequency control - Closed loop speed control of load commutated inverter fed synchronous motor drive.

Permanent Magnet and variable reluctance motor drives – Sinusoidal PMAC drives-Brushless DC motor drives.

Stepper motors, Principles of Automation.

**iv) (a) TEXT BOOKS**

1) Bimal K. Bose "Modern power electronics and AC drives" Pearson Education, Asia 2003.
2) Gopal K. Dubey. "Fundamentals of Electric Drives", second edition, Narosa Publishing house, 2001.
3) Kothari D. P. and I. J. Nagrath, Electrical Machines, Tata McGraw Hill, 2004.
4) Nagrath .I.J. & Kothari .D.P, Electrical Machines, Tata McGraw-Hill, 1998.

**(b) REFERENCES**

1) M D.Singh, K. B. Khanchandani, Power Electronics, Tata McGraw-Hill, 1998.
2) Dewan S.B., G. R. Slemon, A. Strauvhen, "Power semiconductor drives", John Wiley and sons, 1987.
3) Dr. P. S. Bimbra "Power electronics", Khanna publishers. 3. Dubey G. K. "Power semiconductor control drives" Prentice Hall, Englewood Cliffs, New Jersey, 1989.
4) N. K. De, P. K. Sen "Electric drives" Prentice Hall of India, 2002.
5) Ned Mohan, Tore M. Undeland, William P Robbins, "Power electronics converters applications and design", John Wiley and Sons, 2003.
6) Pillai S. K. "A first course on electric drives", Wiley Eastern Ltd, New Delhi, 3rd edition, 2000.
7) Vedam Subrahmanyam, "Electric Drives", Mc Graw Hill Education, New Delhi, 2013.
8) R. Krishnan, "Electric Motor Drives Modeling, Analysis and Control", Prentice Hall of India, 2007.

**v) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | **Introduction to electric drives –** Block diagram – advantages of electric drives – Dynamics of motor load system, fundamental equations, and types of load – classification of load torque, four quadrant operation of drives. Steady state stability. Introduction to closed loop control of drives. | **8** |
| II | **DC Motors -** principle of operation - emf equation - types of excitations. Separately excited, shunt and series excited<br>**DC motor drives -** constant torque and constant power operation, separately excited dc motor drives using controlled rectifiers - Single phase fully controlled converter drives, Chopper controlled DC drives – classification. | **10** |
| III | **Three phase induction motors -** slip ring and squirrel cage types, principles of operation – rotating magnetic field - torque slip characteristics.<br>**Induction Motor Drives -** Three phase induction motor speed control using semiconductor devices. Stator voltage control – stator frequency control – Stator voltage and frequency control (v/f) - Voltage source inverter control - Rotor chopper speed control – slip power recovery control scheme. | **10** |
| IV | **Synchronous motors –** Working principle<br>**Synchronous motor drives –** Synchronous motor variable speed drives - variable frequency control - modes of variable frequency control. Closed loop speed control of load commutated inverter fed synchronous motor drive.<br>**Permanent Magnet and variable reluctance motor drives –** different types – Sinusoidal PMAC drives - Brushless DC motor drives - control requirements, converter circuits, modes of operation. | **8** |
| V | **Stepper motors -** Principle of operation, Linear stepper motor, comparison, | **9** |

| | | |
|---|---|---|
| | Torque-speed characteristics, control of stepper motors.<br>**Controllers for automation -** Servo control, Digital controllers, Advanced control systems, Digital signal processors, motor controllers, Axis controllers, Machine tool controllers, Programmable Logic Controllers. | |
| | **Total hours** | **45** |

**vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | | |
|---|---|---|
| Attendance | : | 10 marks |
| CA Exams (2 numbers) | : | 25 marks |
| Assignment/Project/Case study etc. | : | 15 marks |
| **Total** | : | **50 marks** |

**viii) MARK DISTRIBUTION**

| Total Marks | CIE | ESE | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| EE0U33Z | INTRODUCTION TO FLIGHT DYNAMICS AND CONTROL | OEC | 3 | 0 | 0 | 3 | 2022 |

i) **PRE-REQUISITE:** MAT201 - Complex Analysis and Transforms

ii) **COURSE OVERVIEW**: The main goal of this course is to present the fundamentals of aerodynamics of flight and its motion. This course discusses the various control surfaces and systems in an aircraft. It gives an insight into the performance measures, dynamics, static and dynamic stability of aircrafts.

iii) **COURSE OUTCOMES**

After the completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO1 | Develop state space and transfer function models of an LTI system. | Apply |
| CO2 | Apply time domain techniques to analyse the stability of a linear system | Apply |
| CO3 | Explain the basic concepts of flight, aircraft aerodynamics and flight mechanics. | Understand |
| CO4 | Explain the various control surfaces and performance measures in flight control systems | Understand |
| CO5 | Solve for various performance measures in aircraft | Understand |
| CO6 | Describe the concepts of static and dynamic stability, various modes and control of aircraft. | Understand |

iv) **SYLLABUS**

Introduction to open loop and closed loop control systems - Transfer function - Time domain analysis - Introduction to state space - controllability & observability.

Concept of stability - Routh Hurwitz stability criterion - Root locus - Stability analysis using Root Locus

Introduction to Aerodynamics - Aerodynamic flows. Airfoil nomenclature - Wing geometry - Aerodynamic forces and moments - aerodynamic coefficients - Control surfaces - Wind tunnels. Drag Polar - Equation of motion of aircraft - Rate of climb - range and endurance - gliding flight - landing performance - V-n diagram.

Static and dynamic stability - Longitudinal and lateral dynamics – Autopilots - Displacement autopilots - Stability augmentation system.

v) **(a) TEXT BOOKS**


1) John D Anderson Jr., *Introduction to Flight*, McGraw Hill International, 6th edition, 2017.
2) Katsuhiko Ogata, *Modern Control Engineering*, Prentice Hall of India, New Delhi, 5th edition, 2010.
3) Robert C Nelson, *Flight Stability and Automatic Contro*l, McGraw-Hill Education, 2nd edition, 1996.

**(b) REFERENCES**


1) Bernard Etkin, *Dynamics of flight Stability and Control*, John Wiley and Sons Inc. 7th edition, 2011.
2) Nagarath I. J. and Gopal M, *Control System Engineering*, New Age International, 6th edition, 2017.
3) Nise N. S., *Control Systems Engineering*, Wiley Eastern, 6th edition, 2010.
4) Richard S.Shevell, *Fundamentals of Flight* Pearson Education Inc., 2nd edition , 2004.
5) R.F Stengel, *Flight dynamics*, Princeton University Press, Princeton, N.J., USA, 2004.
6) John D Anderson *Aircraft Performance & Design*. McGraw-Hill Education, 1999
7) A C Kermode, *Flight Without Formulae*, Pearson Education Inc., 5th edition, 2004.
8) Thomas R. Yechout, *Introduction to Aircraft Flight Mechanics: Performance, Static Stability, Dynamic Stability, Feedback Control and State-Space Foundations*, AIAA Education Series, 2014.


**vi) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | Introduction to control system: Open loop and closed loop control systems - Transfer function of LTI systems – characteristic equation – Type and order of system. Time domain analysis of control systems: Standard test signals– Transient and steady state responses – first and second order systems –time domain specifications – step responses of first and second order systems.<br>Introduction to state space: state equation of linear continuous time systems – Eigen values and Eigen vectors of system matrix – concept of controllability & observability – relationship between state equations and transfer function. | 8 |
| II | **Concept of stability:** Bounded Input Bounded Output stability – stability of feedback system – location of poles and stability – Routh Hurwitz stability criterion.<br>**Root locus:** General rules for constructing Root loci – stability from root loci – effect of addition of poles and zeros.<br>**Introduction to Aerodynamics:** standard atmosphere – definition of altitudes– density, pressure and temperature altitudes. Aerodynamic flows – inviscid and viscous flows – incompressible and compressible flows – Mach number – laminar and turbulent flows – Reynolds number. | 10 |
| III | **Airfoils**: Airfoil nomenclature – symmetric and cambered airfoils –generation of lift. Wing geometry –aspect ratio – chord line – angle of attack.<br>Aerodynamic forces and moments– aerodynamic coefficients – lift, drag and moment coefficients– lift curve, drag curve – stalling of airfoil.<br>Control surfaces: elevator – aileron – rudder – dihedral angle and its effects – flaps and slots – spoilers.<br>Flow similarity – Wind tunnels – open and close wind tunnels. | 9 |
| IV | **Aircraft Performance**: Drag Polar – Equation of motion of aircraft for level, un–accelerated flight. Thrust and power required for level, un–accelerated flight– thrust and power available – condition for maximum velocity. | 9 |

| | | |
|---|---|---|
| | Rate of climb– gliding flight– time to climb – range and endurance – takeoff performance – landing performance – Turning flight – wing loading – load factor – V-n diagram. | |
| **V** | **Aircraft Stability and Control**: Static and dynamic stability – conditions for longitudinal static stability. Longitudinal and lateral dynamics (linear state space model) – Longitudinal dynamic modes - short period, phugoid. Lateral and directional dynamic stability – Spiral divergence and dutch roll (concepts only - mathematical derivations not needed)<br>**Autopilots**: Control surface actuator – Displacement autopilots – pitch displacement autopilot – attitude hold and velocity hold control systems – block diagrams – Stability augmentation system. | **9** |
| | **Total hours** | **45** |

**vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | |
|---|---|
| Attendance | 10 marks |
| CA Exams (2 numbers) | 25 marks |
| Assignment/Project/Case study etc. | 15 marks |
| **Total** | **50 marks** |

**viii) MARK DISTRIBUTION**

| Total Marks | CIE | ESE | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| EE0U41D | ELECTRIC VEHICLES | OEC | 2 | 1 | 0 | 3 | 2020 |

**i) PRE-REQUISITE:** Nil

**ii) COURSE OVERVIEW**: The main goal of this course is to expose the students to the fundamental concepts and trends in electric and hybrid vehicles. It gives an insight into the drive system, battery management system and energy sources used in electric vehicles. It also intends to deliver various communication protocols.

**iii) COURSE OUTCOMES**

After the completion of the course, the student will be able to:

| | | |
|---|---|---|
| CO1 | Explain the basic concepts of Electric and Hybrid Electric Vehicles. | Understand |
| CO2 | Compare various configurations of Electric and Hybrid Electric drive trains based on application | Understand |
| CO3 | Explain the propulsion unit for electric and hybrid vehicles. | Understand |
| CO4 | Compare proper energy storage systems for vehicle applications. | Understand |
| CO5 | Compare various communication protocols and technologies used in vehicle networks. | Understand |

**iv) SYLLABUS**

Conventional Vehicles, Basics of vehicle performance, Basic Architecture of hybrid traction, Power flow control.

Electric Propulsion unit, Configuration and control of DC motor drives, Induction Motor drives.

Energy Storage Requirements in Hybrid and Electric Vehicles, Battery, fuel cell, flywheel and supercapacitor-based energy storage.

Design of electric and hybrid electric vehicle, sizing of components.

Communication Systems, Energy Management Strategies, EV charging technologies and policies.

**v) (a) TEXT BOOKS**

1) Iqbal Husain, "Electric and Hybrid vehicles: Design Fundamentals", CRC press, 3rd Edition, 2021.
2) Ehsani M., "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005.
3) GianfranCOPistoia, "Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and the Market", Elsevier, 2010.

4) Chan C. C. and Chau K. T., "Modern Electric Vehicle Technology", Oxford University Press, 2001.

**(b) REFERENCES**

1) James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition Wiley 2003.
2) Fuhs A. E., "Hybrid Vehicles and the Future of Personal Transportation", CRC Press, 2009.
3) Chris Mi, Abul Masrur M., "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", 2nd Edition, John Wiley & Sons Ltd, 2017.
4) Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.

**(c) ONLINE RESOURCES**

1) NPTEL courses/Materials (IITG, IITM,IITD) – Electric and Hybrid vehicles
https://nptel.ac.in/courses/108/103/108103009/ (IIT Guwahati)
https://nptel.ac.in/courses/108/102/108102121/ (IIT Delhi)
https://nptel.ac.in/courses/108/106/108106170/ (IIT Madras)
2) FOC Control - video lecture by Texas Instruments
https://training.ti.com/kr/field-oriented-control-permanent-magnet-motors
3) Sensored and sensorless FOC control of PMSM motors – Application notes (TI, MATLAB)
https://www.ti.com/lit/an/sprabz0/sprabz0.pdf?ts=1620018267996&ref_url=https%253A%252F%252Fwww.google.com%252F
https://in.mathworks.com/help/physmod/sps/ref/pmsmfieldorientedcontrol.html
4) Electric Vehicle Conductive AC Charging System
https://dhi.nic.in/writereaddata/UploadFile/REPORT%20OF%20COMMITTEE636469551875975520.pdf
Electric Vehicle Conductive AC Charging System

**vi) COURSE PLAN**

| Module | Contents | No. of hours |
|---|---|---|
| I | **Introduction to Hybrid Electric Vehicles**: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.<br>**Basics of vehicle performance**, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. | 9 |

| | | |
|---|---|---|
| **II** | **Hybrid Electric Drive-trains**: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies.<br>**Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies. | **9** |
| **III** | **Electric Propulsion unit:** Introduction to electric components used in hybrid and electric vehicles. Configuration and control of separately excited DC motors, Induction Motors (block diagram representation of FOC). | **9** |
| **IV** | **Energy Storage**: Introduction to energy storage requirements in Hybrid and Electric Vehicles- Battery based energy storage systems - Fuel Cell based energy storage systems- Introduction to Supercapacitors and Hydrogen energy storage - Hybridization of different energy storage devices.<br>**Types of charging stations** - AC Level 1 & 2, DC - Level 3 –V2G concept. | **10** |
| **V** | **Communications**, supporting subsystems: In vehicle networks- Communication Protocols - CAN, LIN, FLEXRAY (Basics only).<br>**Introduction to energy management strategies**: Classification of different energy management strategies, comparison of different energy management strategies. | **8** |
| | **Total hours** | **45** |

**vii) CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | | |
|---|---|---|
| Attendance | : | 10 marks |
| CA Exams (2 numbers) | : | 25 marks |
| Assignment/Project/Case study etc. | : | 15 marks |
| **Total** | : | **50 marks** |

**viii) MARK DISTRIBUTION**

| Total Marks | CIE | ESE | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CS0U41A | INTRODUCTION TO MOBILE COMPUTING | OEC | 2 | 1 | 0 | 3 | 2020 |

i. **PRE-REQUISITE:** CS1U30B Computer Networks

ii. **COURSE OVERVIEW**

The purpose of this course is to prepare learners to understand the functionalities and design considerations of mobile computing. The course content is designed to cover the mobile computing architecture, features of different communication systems and major elements of mobile security and next generation computer systems. This course enables the learners to acquire advanced concepts on mobile and ad-hoc networks.

iii. **COURSE OUTCOMES**

After the completion of the course the student will be able to

| | | |
|---|---|---|
| CO1 | Describe the mobile computing applications, services, design considerations and architectures | Understand |
| CO2 | Identify the technology trends for cellular wireless networks . | Understand |
| CO3 | Summarize the Short Messaging Service and General Packet Radio Service | Understand |
| CO4 | Outline the LAN technologies used in mobile communication. | Understand |
| CO5 | Describe the security protocols and apply suitable security algorithm to secure the communication . | Apply |
| CO6 | Explain the fundamental concepts of next generation mobile networks. | Understand |

iv. **SYLLABUS**

Mobile Computing Architecture, Communication Systems, Satellite communication systems, Mobile computing through telephone ,Short Messaging Service and General Packet Radio Service, Wireless Local Area Networks, Mobile Security and Next Generation Networks.

v. **(a) TEXT BOOKS**


1. Asoke K. Talukder, Hasan Ahmad, Roopa R Yavagal, Mobile Computing Technology- Application and Service Creation, 2nd Edition, McGraw Hill Education.
2. Schiller J., Mobile Communications, 2/e, Pearson Education, 2009


**(b) OTHER REFERENCES**


1. Andrew S. Tanenbaum, Computer Networks, 6/e, PHI.
2. Theodore S. Rappaport, Wireless Communications Principles and Practice, 2/e, PHI, New Delhi, 2004.
3. Curt M. White, Fundamentals of Networking and Communication 7/e, Cengage learning

**vi. COURSE PLAN**

| Module | Contents | No.of Hours |
|---|---|---|
| I | **Mobile Computing Architecture**<br>Introduction to mobile computing – Functions, Devices, Middleware and gateways, Applications, services, limitations, Internet: The ubiquitous network, Three-tier architecture, Three-tier architecture Design considerations for mobile computing ,Design considerations for mobile computing | 7 |
| II | **Communication Systems**<br>Evolution of telephony, Multiple access procedures –FDMA, TDMA, CDMA, SDMA, Satellite communication systems – GEO, MEO, LEO, Satellite phones, Interactive Voice Response (IVR) architecture, Overview of voice software, Developing an IVR application (Call flow diagram), Introduction to GSM, Architecture, GSM entities, Call routing, Mobility management, Frequency allocation, Authentication and security | 10 |
| III | **Short Messaging Service and General Packet Radio Service**<br>SMS Strengths, Architecture, Short Message Mobile Terminated (SM MT) and Short Message Mobile Originated (SM MO) messages, SMS Architecture - Operator-centric pull, operator-independent push/pull, Value added services, Accessing the SMS bearer Accessing the SMS bearer , GPRS architecture, Network operations<br>Data services, Applications, Limitations, Billing and charging | 10 |
| IV | **Wireless Local Area Networks**<br>WLAN Advantages, Evolution, Applications, WLAN Architecture , WLAN Architecture<br>Mobility, Security, Deploying WLAN, WLL Architecture, HIPERLAN, WiFi Vs 3G | 8 |
| V | **Mobile Security and Next Generation Networks**<br>Information security – Attacks, Components, Security techniques and algorithms – Stream Vs Block cipher, Symmetric Vs Asymmetric cryptography, Security techniques and algorithms – RSA, Diffie Hellman Key exchange, Security protocols – Secure Socket Layer, Transport Layer Security, Wireless Transport Layer Security, The Converged Scenario, Narrowband to broadband, Orthogonal Frequency Division Multiplexing (OFDM) and Multi Protocol Label Switching (MPLS), Wireless Asynchronous Transfer Mode (WATM) and Multimedia broadcast services | 10 |
| | **Total hours** | **45** |

**vi. CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | |
|---|---|
| Attendance | : 10 marks |
| Continuous Assessment Tests (Average of Series Tests1& 2) | : 25 marks |
| Continuous Assessment Assignment | : 15 marks |
| **Total Marks** | **: 50 marks** |

**vii. MARK DISTRIBUTION**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 Hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CS0U41B | INTRODUCTION TO DEEP LEARNING | OEC | 2 | 1 | 0 | 3 | 2020 |

**i. PRE-REQUISITE:** Nil

**ii. COURSE OVERVIEW**

This course aims to introduce the learner to an overview of the concepts and algorithms involved in deep learning. Basic concepts and application areas of machine learning, deep networks, convolutional neural network and recurrent neural network are covered in this course. This is a foundational program that will help students understand the capabilities, challenges, and consequences of deep learning and prepare them to participate in the development of leading-edge AI technology. They will be able to gain the knowledge needed to take a definitive step in the world of AI.

**iii. COURSE OUTCOMES**

After the completion of the course the student will be able to

| | | |
|---|---|---|
| CO1 | Demonstrate basic concepts in machine learning. | Understand |
| CO2 | Illustrate the validation process of machine learning models using hyper-parameters and validation sets. | Understand |
| CO3 | Demonstrate the concept of the feed forward neural network and its training process. | Apply |
| CO4 | Build CNN and Recurrent Neural Network (RNN) models for different use cases. | Apply |
| CO5 | Use different neural network/deep learning models for practical applications. | Apply |

**iv. SYLLABUS**

Supervised learning- regression, classification, tagging, web search, page ranking, recommender systems, sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Other Concepts - overfitting, underfitting , hyperparameters and validation sets, estimators, bias and variance.

Optimization and Neural Networks: Neural Networks, Multilayer perceptron, activation functions, architecture design. Introduction to optimization– Gradient based optimization, linear least squares. Stochastic gradient descent, Building ML algorithms and challenges. Convolutional Neural Network: Convolutional Neural Networks ,Convolution and Pooling as an infinitely strong prior, variants of convolution functions, structured outputs, data types, efficient convolution algorithms.

Recurrent neural networks – Computational graphs, RNN design, encoder – decoder sequence to sequence architectures, deep recurrent networks, recursive neural networks. Applications – computer vision, speech recognition, natural language processing. Research Areas – Autoencoders, Representation learning, Boltzmann Machines, Deep belief networks.

**v. (a)TEXT BOOKS**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press 2015 ed.

2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, August 2019.
3. Neural Networks and Deep Learning: A Textbook by Charu C. Aggarwal. Springer.1st edition, 2018.

**(b) OTHER REFERENCES**

1. Neural Smithing: Supervised Learning in Feed forward Artificial Neural Networks by Russell Reed, Robert J MarksII, 1st edition, 1999, MIT Press.
2. Practical Convolutional Neural Networks by Mohit Sewak, Md. Rezaul Karim, Pradeep Pujari, 1st edition, 2018, Packt Publishing Ltd.
3. Hands-On Deep Learning Algorithms with Python by Sudharsan Ravichandran, 1st edition, 2019, Packt Publishing Ltd.
4. Deep Learning with Python by Francois Chollet, 2nd edition, 2018, Manning Publications

**vi. COURSE PLAN**

| Module | Contents | No.of Hours |
|---|---|---|
| I | **Introduction**<br>Key components - Data, models, objective functions, optimization algorithms, Learning algorithm, Supervised learning- regression, classification, tagging, web search, page ranking ,Recommender systems, Sequence learning, Unsupervised learning, Reinforcement learning, Historical Trends in Deep Learning. Concepts: overfit, underfit, hyperparameters and validation sets, Concepts: Estimators, bias and variance., Demonstrate the concepts of supervised learning algorithms using a suitable platform, Demonstrate the concepts of unsupervised using a suitable platform. | 8 |
| II | **Optimization and Neural Networks**<br>Perceptron, Stochastic Gradient descent, Gradient descent solution for perceptron ,Multilayer perceptron, , Activation functions- Sigmoid, tanh, Softmax, ReLU, leaky ReLU Architecture design, Chain rule, back propagation,Gradient based learning, Gradient based optimization, Linear least squares using a suitable platform. Building ML Algorithms and Challenges | 9 |
| III | **Convolution Neural Network**<br>Convolution operation, Motivation, pooling ,Convolution and Pooling as an infinitely strong prior ,Variants of convolution functions – multilayer convolutional network, tensors, kernel flipping, downsampling, strides and zero padding. Variants of convolution functions - unshared convolutions, tiled convolution, training different networks, Structured outputs, data types, Efficient convolution algorithms., Case Study:<br>AlexNet, VGG, ResNet. | 10 |
| IV | **Recurrent Neural Network**<br>Computational graphs, RNN ,Encoder – decoder sequence to sequence architectures. Deep recurrent networks .Recursive neural networks ,<br>Modern RNNs, LSTM and GRU, Practical use cases for RNNs,<br>Demonstrate the concepts of RNN using a suitable platform. | 10 |

| | | |
|---|---|---|
| V | **Applications and Research**<br>Computer vision. Speech recognition, Natural language processing., Brief introduction on current research areas- Autoencoders, Representation learning. Brief introduction on current research areas- Boltzmann Machines, Deep belief networks. | 8 |
| | **Total hours** | **45** |

**vii. CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | |
|---|---|
| Attendance | : 10 marks |
| Continuous Assessment Tests (Average of Series Tests1& 2) | : 25 marks |
| Continuous Assessment Assignment | : 15 marks |
| **Total Marks** | **: 50 marks** |

**viii. MARK DISTRIBUTION**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 Hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CS0U41C | COMPUTER GRAPHICS | OEC | 2 | 1 | 0 | 3 | 2020 |

i. **PRE-REQUISITE:** Nil

ii. **COURSE OVERVIEW:**

This course helps the learners to make awareness about strong theoretical concept in computer graphics. It covers the three-dimensional environment representation in a computer, transformation of 2D/3D objects and basic mathematical techniques and algorithms used to build applications. This course enables the learners to develop the ability to create image processing frameworks for different domains and develop algorithms for emerging display technologies.

iii. **COURSE OUTCOMES**

After the completion of the course the student will be able to

| | | |
|---|---|---|
| CO1 | Describe the working principles of graphics devices. | Understand |
| CO2 | Illustrate line drawing, circle drawing and polygon filling algorithms. | Apply |
| CO3 | Demonstrate geometric representations and transformations on 2D & 3D objects | Apply |
| CO4 | Demonstrate the working of line and polygon clipping algorithms | Apply |
| CO5 | Summarize visible surface detection methods and illustrate projection algorithms. | Apply |

iv. **SYLLABUS**

Basic Concepts in Computer Graphics. Input devices. Display devices. Line and circle drawing Algorithms. Solid area scan-conversion. Polygon filling. Two dimensional transformations. Windowing, clipping. 3D Graphics, 3D transformations. Projections – Parallel, Perspective. Hidden Line Elimination Algorithms.

v. **(a) TEXT BOOKS**


1. Zhigang Xiang and Roy Plastock, Computer Graphics (Schaum's outline Series), McGraw Hill, 2019.
2. Donald Hearn and M. Pauline Baker, Computer Graphics, PHI, 2e, 1996


**(b) OTHER REFERENCES**


1. William M. Newman and Robert F. Sproull, Principles of Interactive Computer Graphics. McGraw Hill, 2001
2. David F. Rogers , Procedural Elements for Computer Graphics, Tata McGraw Hill,2001.
3. Donald Hearn, M. Pauline Baker and Warren Carithers, Computer Graphics with OpenGL, PHI, 4e, 2013

vi. **COURSE PLAN**

| Module | Contents | No.of Hours |
|---|---|---|
| I | **Basics of Computer Graphics**<br>Basics of Computer Graphics and applications, Refresh Cathode Ray Tubes, Random Scan Displays and systems, Raster scan displays and systems, Color CRT displays Flat panel display and its categories. | 7 |
| II | **Line drawing, Circle drawing and Filled Area Primitives**<br>DDA Line drawing Algorithm, Bresenham's line drawing algorithm, Midpoint Circle generation algorithm, Bresenham's Circle generation algorithm, Illustration of line drawing and circle drawing algorithms, Scan line polygon filling, Boundary filling and flood filling | 10 |
| III | **Geometric transformations**<br>Basic 2D transformations-Translation and Rotation, Basic 2D transformations-Scaling, Reflection and Shearing, Illustration of 2D Transformations, Composite transformations, Matrix representations and homogeneous coordinates, Basic 3D transformations, Illustration of basic 3D transformations | 9 |
| IV | **2D Clipping**<br>Window to viewport transformation, Cohen Sutherland Line clipping algorithm, Midpoint subdivision Line clipping algorithm<br>Sutherland Hodgeman Polygon clipping algorithm, Weiler Atherton Polygon clipping algorithm, Practice problems on Clipping algorithms | 10 |
| V | **Three dimensional graphics**<br>Three dimensional viewing pipeline, Projections-Parallel projections, Projections- Perspective projections, Visible surface detection algorithms- Back face detection., Depth buffer algorithm, Depth buffer algorithm, Scan line visible surface detection algorithm, Scan line visible surface detection algorithm, A buffer algorithm | 9 |
| | **Total hours** | **45** |

vii. **CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | |
|---|---|
| Attendance | : 10 marks |
| Continuous Assessment Tests (Average of Series Tests1& 2) | : 25 marks |
| Continuous Assessment Assignment | : 15 marks |
| **Total Marks** | **: 50 marks** |

viii. **MARK DISTRIBUTION**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 Hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CS0U41D | PYTHON FOR ENGINEERS | OEC | 2 | 1 | 0 | 3 | 2020 |

i. **PRE-REQUISITE:** Nil

ii. **COURSE OVERVIEW**

The objective of the course is to provide learners an insight into Python programming in a scientific computation context and develop programming skills to solve engineering problems. It covers programming environment, important instructions, data representations, intermediate level features, Object Oriented Programming and file data processing of Python. This course lays the foundation to scientific computing, develop web applications, Machine Learning, and Artificial Intelligence-based applications and tools, Data Science and Data Visualization applications.

iii. **COURSE OUTCOMES**

After the completion of the course the student will be able to

| | | |
|---|---|---|
| CO1 | Explain the data types, operators and keywords in Python. | Apply |
| CO2 | Illustrate uses of conditional and iterative statements in Python programs. | Apply |
| CO3 | Develop programs by utilizing the Python programming constructs functions and data structures in Python. | Apply |
| CO4 | Implement Object Oriented programs using exception handling. | Apply |
| CO5 | Analyze, Interpret, and Visualize data according to the target application. | Apply |
| CO6 | Implement programs in Python to process data stored in files by utilizing Numpy, Matplotlib, and Pandas. | Apply |

iv. **SYLLABUS**

Basics of Python, using editors, detecting and correcting syntax errors, using built in functions and modules in math module, Testing the control statements, Lazy evaluation. Functions and Python Data Structures, working with tuples-Sets-list- dictionaries. Object Oriented Programming Structuring classes with Inheritance and Polymorphism, abstract Classes, exceptions. Visualization and File handling using packages.

v.(a) **TEXT BOOKS**


1. Kenneth A Lambert., Fundamentals of Python: First Programs, 2/e, Cengage Publishing, 2016
2. David J. Pine, Introduction to Python for Science and Engineering, CRC Press, 2021


**(b) OTHER REFERENCES**


1. Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016

3. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
4. David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.
5. Charles Severance. Python for Informatics: Exploring Information,
6. http://swcarpentry.github.io/python-novice-gapminder/

**vi. COURSE PLAN**

| Module | Contents | No.of Hours |
|---|---|---|
| I | **Basics of Python**<br>Getting Started with Python Programming: Running code in the interactive shell Editing, Saving, and Running a script, Using editors: IDLE, Jupyter, Basic coding skills: Working with data types, Numeric data types and Character sets, Keywords, Variables and Assignment statement, Operators, Expressions, Working with numeric data, Type conversions, Comments in the program, Input Processing, and Output. Formatting output, How Python works. Detecting and correcting syntax errors. Using built in functions and modules in math module. Control statements : Selection structure, if-else, if elif else, Iteration structure - for, while Testing the control statements, Lazy evaluation. | 9 |
| II | **Functions and Python Data Structures**<br>Functions: Hiding redundancy and complexity, Arguments and return values, Variable scopes and parameter passing, Named arguments, Main function, Working with recursion, Lambda functions, Strings - String function, Lists - Basic list Operations and functions, List of lists, Slicing, Searching and sorting list, List comprehension, Work with tuples. Sets, Dictionaries - Dictionary functions, dictionary literals, adding and removing keys, Accessing and replacing values, traversing dictionaries, reverse lookup | 9 |
| III | **Object Oriented Programming**<br>Design with classes : Objects and Classes, Methods, Instance Variables Constructor, Accessors, and Mutators, Structuring classes with Inheritance, Polymorphism, Abstract Classes, Exceptions: Handle a single exception, Handle multiple exception | 8 |
| IV | **Visualization and File handling**<br>Plotting - An Interactive Session with PyPlot, Basic Plotting, Logarithmic Plots, More Advanced Graphical Output, Plots with multiple axes, Mathematics and Greek symbols, The Structure of matplotlib, Contour and Vector Field Plots File Processing -The os and sys modules, Introduction to file I/O, Reading and writing text files, Working with CSV files | 9 |
| V | **Scientific Computing**<br>Numerical Routines: SciPy and NumPy - Basics, Creating arrays, Arithmetic, Slicing, Matrix Operations, Special Functions, Random Numbers, Linear Algebra, Solving Nonlinear Equations Numerical Integration, Solving ODEs, Data Manipulation and Analysis: Pandas - Reading Data from Files Using Pandas, Data Structures - Series and DataFrame, Extracting Information from a DataFrame, Grouping and Aggregation | 10 |
| | **Total hours** | **45** |

**vii. CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | |
|---|---|
| Attendance | : 10 marks |
| Continuous Assessment Tests (Average of SeriesTests1& 2) | : 25 marks |
| Continuous Assessment Assignment | : 15 marks |
| **Total Marks** | **: 50 marks** |

**viii. MARK DISTRIBUTION**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 Hours |

| Course Code | Course Name | Category | L | T | P | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|
| CS0U41E | OBJECT ORIENTED CONCEPTS | OEC | 2 | 1 | 0 | 3 | 2020 |

i. **PRE-REQUISITE:** Nil

ii. **COURSE OVERVIEW**

The purpose of this course is to enable learners to solve problems by breaking it down to object level while designing software and to implement it using Java. This course covers Object Oriented Principles, Object Oriented Programming in Java, Exception handling, Event handling, multithreaded programming and working with window-based graphics. This course provides learners the basics to develop Mobile applications, Enterprise Applications, Scientific Applications and Web based Applications.

iii. **COURSE OUTCOMES**

After the completion of the course the student will be able to

| | | |
|---|---|---|
| CO1 | Develop Java programs using the object-oriented concepts - classes, objects, constructors, data hiding, inheritance and polymorphism. | Apply |
| CO2 | Utilize data types, operators, control statements, built in packages & interfaces, Input/output Streams and Files in Java to develop programs . | Apply |
| CO3 | Illustrate how robust programs can be written in Java using exception handling mechanism | Apply |
| CO4 | Develop application programs in Java using multithreading . | Apply |
| CO5 | Develop Graphical User Interface based application programs by utilizing event handling features and Swing in Java | Apply |

iv. **SYLLABUS**

Object Orientation and Java basics: Object Orientation Principles, Introduction to Java Primitive Data types, Arrays, Strings, Vector class.

Core Java Fundamentals: Operators, Control Statements, Object Oriented Programming in Java - Class Fundamentals, Overloading, Recursion, Access Control, Command-Line Arguments.
More features of Java: Inheritance - The Keyword *super*, protected Members, Method Overriding, Abstract Classes and Methods, Packages and Interfaces, Exception Handling.
Advanced features of Java:Input/Output - I/O Basics Reading and Writing Files, String Handling, Comparison of String Buffer and String.
GUI Programming, Event Handling and Multithreaded Programming: Multithreaded Programming, Event Handling - Delegation Event Model, Using the Delegation Model. Swing Fundamentals - Model View Controller (MVC), Exploring Swing - JFrame, JLabel, JButton, JTextField.

**v. (a)TEXT BOOKS**

1. Schildt, Java: The Complete Reference, 8/e, Tata McGraw Hill, 2011.
2. Balagurusamy E., Programming JAVA a Primer, 5/e, McGraw Hill, 2014.

**(b) OTHER REFERENCES**

1. Paul Deitel, Harvey Deitel, Java How to Program, Early Objects 11/e, Pearson, 2018.
2. Y. Daniel Liang, Introduction to Java Programming, 7/e, Pearson, 2013.
3. Nageswararao R., Core Java: An Integrated Approach, Dreamtech Press, 2008.
4. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
5. Sierra K., Head First Java, 2/e, O'Reilly, 2005.

**vi. COURSE PLAN**

| Module | Contents | No.of Hours |
|---|---|---|
| I | **Object Orientation and Java basics**<br>Object Orientation Principles – Object and Class, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of using Object orientation, Java programming Environment and Runtime Environment, Development Platforms -Standard, Enterprise. JVM, Java compiler, Bytecode, Java applet, Java Buzzwords, Java program structure, Comments, Garbage Collection, Lexical Issues, Primitive Data types - Integers, Floating Point Types, Characters, Boolean, Literals, Type Conversion and Casting, Variables, Arrays, Strings, Vector class | 8 |
| II | **Core Java Fundamentals**<br>Operators - Arithmetic Operators, Bitwise Operators, Relational Operators, Boolean Logical Operators, Assignment Operator, Conditional (Ternary) Operator, Operator Precedence, Control Statements - Selection Statements, Iteration Statements and Jump Statements, Object Oriented Programming in Java - Class Fundamentals, Declaring Objects, Object Reference, Introduction to Methods, Constructors, this Keyword, Method Overloading, Using Objects as Parameters, Returning Objects, Recursion, Access Control, static Members, Command-Line Arguments, Variable Length Arguments | 9 |
| III | **More features of Java**<br>Inheritance - Super class, Sub class, the keyword super, protected Members, Calling Order of Constructors, Method Overriding, the Object class, Abstract Classes and Methods, Using final with Inheritance, Packages and Interfaces - Defining Package, CLASSPATH, Access Protection, Importing Packages, Interfaces, Exception Handling - Checked Exceptions, Unchecked Exceptions, try Block and catch Clause, Multiple catch Clauses, Nested try Statements, throw, throws and finally | 9 |

| | | |
|---|---|---|
| IV | **Advanced features of Java**<br>Input/Output - I/O Basics, Reading Console Input, Writing Console Output, PrintWriter Class, Working with Files , Java Library - String Handling – String Constructors, String Length, Special String Operations - Character Extraction, String Comparison, Searching Strings, Modifying Strings, Using valueOf( ), Comparison of StringBuffer and<br>String. | 9 |
| V | **GUI Programming, Event Handling and Multithreaded Programming**<br>Multithreaded Programming - The Java Thread Model, The Main Thread, Creating Thread, Creating Multiple Threads, Suspending, Resuming and Stopping Threads, Event handling - Event Handling Mechanisms, Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces, Using the Delegation Model, Swing fundamentals, Swing Key Features, Model View Controller (MVC), Swing Controls, Components and Containers, Exploring Swing –JFrame, JLabel, JButton, JTextField | 10 |
| | **Total hours** | **45** |

**vii. CONTINUOUS ASSESSMENT EVALUATION PATTERN**

| | |
|---|---|
| Attendance | : 10 marks |
| Continuous Assessment Tests (Average of SeriesTests1& 2) | : 25 marks |
| Continuous Assessment Assignment | : 15 marks |
| **Total Marks** | **: 50 marks** |

**viii. MARK DISTRIBUTION**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|---|---|---|---|
| 150 | 50 | 100 | 3 Hours |