## Fourth Semester

| | |
|---|---|
| **Course Title: Analog Circuits** | |
| **Course Code: 24UEC401T** | **Course Category: PCC** |
| **Teaching Scheme: L – T – P** | **Total Credits:** 03 |
| **3 – 0 – 0** | **Semester:** IV |
| **Scheme of Examination: ESE: 60 Mks, CE: 40 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | To understand basic principles of analog integrated circuits for analog IC design. |
| 2. | To Familiarise with basics of OP-Amp, its parameters and applications. |
| 3. | To make them understand linear and non-linear applications of OP-Amp. |
| 4. | To make them identify data converters and waveform generators. |
| 5. | To make them design special function ICs and design circuits using it. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Describe the basic concept of Operational amplifier, its parameters andapplications. |
| CO2 | Demonstrate and analyze linear and non-linear applications of Op-Amp. |
| CO3 | Design various types of Oscillators. |
| CO4 | Design various types of Active Filters in analog circuits. |
| CO5 | Describe and explain the basic concept of differential amplifier. |
| CO6 | Design special function ICs for various applications |

**Course Contents:**

**UNIT I** **[08 Hours]**

**Op-Amp Fundamentals:**

Block Diagram of Operational Amplifier, Op-Amp Parameters, Input Bias and Offset Currents, Input Bias and Offset Voltage, Ideal OP-Amp, Equivalent Circuit, Voltage Transfer Curve, Virtual Ground Concept, Inverting Amplifier, Non-Inverting Amplifiers, Voltage Follower.

**UNIT II** **[07 Hours]**

**Linear Applications of Op-Amp:**

Unity Gain Amplifier, Summer, Difference Amplifier, Integrator, Differentiator, V to I Converter, I to V Converter, Instrumentation Amplifier and Transducer Bridge Amplifier.

**UNIT III** **[08 Hours]**

**Oscillators:**

Review of the basic concept, Barkhausen's criterion, Wein Bridge Oscillator, RC Phase Shift Oscillator, Square Wave Generator, Triangular Wave Generator.

**UNIT IV** **[07 Hours]**

**Active filters:**

Design of Butterworth n order filter – Low pass, High Pass, Band Pass, Band Stop filters, All Pass Filter, and Higher Order Filters using OP-Amp IC.

**UNIT V** **[07 Hours]**

**Differential amplifiers:**

DC and AC analysis, Constant Current Bias Circuits, Level Shifting Techniques, Cascaded Differential Amplifier stages.

**UNIT VI** **[08 Hours]**

**Non-linear Applications:**

Schmitt Trigger, Sample and Hold Circuit and Log/Antilog Amplifiers Special Function IC's: IC 555 and its Applications, Phase Locked Loops IC 565, D/A Converter, A/D Converter and Recent Trends in Analog Circuits.

**Suggested Self Readings:**

**Text Books**


| | |
|---|---|
| 1. | David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013. |
| 2. | D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', II edition, New Age2003. |
| 3. | Ramakant A. Gayakwad, 'Op-amps and Linear Integrated Circuits', IV edition,Pearson Education, 2003 / PHI. 2000. |
| 4. | Sergio Franco, "Design with Operational Amplifiers and Analog IntegratedCircuits", McGraw Hill. |

**Fourth Semester**

| | |
|---|---|
| **Course Title: Analog Circuits Lab** | |
| **Course Code: 24UEC401P** | **Course Category:PCC** |
| **Teaching Scheme: L – T – P** | **Total Credits:** 01 |
| **0 – 0 – 2** | **Semester:** IV |
| **Scheme of Examination: ESE: 25 Mks, CE: 25 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | To provide the understanding of basic parameters of Operational Amplifier and its applications. |
| 2. | To give the basic principles of Analog Integrated Circuits for Analog ICdesign. |
| 3. | To Enable op-amp to realize various circuits. |
| 4. | To Familiarise them with active filter and timer in the analog circuits. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Design and analyze OP-Amp circuit configurations. |
| CO2 | Analyze OP-Amp circuit parameters and Frequency response. |
| CO3 | Design Linear and Non-Linear applications of OP-Amp. |
| CO4 | Explain and design special function IC applications. |

| Sr. No. | **List of Experiments** |
|---|---|
| 1. | To verify gain and frequency response of Inverting and Non-Inverting Amplifier using IC 741. |
| 2. | To verify OP-Amp parameters a) CMRR b) Slew Rate |
| 3. | Design and Verify OP-Amp application as Adder and Subtractor. |
| 4. | Design and simulate gain and frequency response of Integrator and Differentiator circuit using IC 741 |
| 5. | Design and Simulate Second order Low Pass Filter/High Pass Filter. Alsoverify its frequency response characteristics. |
| 6. | Verify and simulate Schmitt Trigger circuit using IC 741. |
| 7. | Design and Verify Astable and Monostable Multivibrator using Timer IC555. |
| 8. | To construct RC phase shift oscillator and study its operation |

| | |
|---|---|
| 9. | To verify the operation of various types of Clipper and Clamper likepositive and negative IC 741. |
| 10. | To study and verify PLL using IC 565. |
| 11. | Verification of Digital to Analog Converter using R-2R Ladder network. |
| 12. | Mini Project |

**Fourth Semester**

| **Course Title: Analog & Digital Communication** | |
|---|---|
| **Course Code: 24UEC402T** | **Course Category: PCC** |
| **Teaching Scheme: L – T – P** | **Total Credits: 04** |
| **3 – 1 – 0** | |
| **Scheme of Examination: ESE: 60 Mks, CE: 40 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Enable the students to learn basic principles and techniques used in analog and digital communications. |
| 2. | Introduce analog and digital modulation techniques, communication receiver and transmitter design, |
| 3. | Explore analytical techniques to evaluate the performance of communication systems. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Demonstrate a basic need of modulation and various types of amplitude andangle modulation techniques required for analog communication. |
| CO2 | Analyze various parameters of AM-FM receivers, along with the effect of noiseon analog communication systems. |
| CO3 | Design digital communication systems by applying knowledge of the variousmodulation techniques. |
| CO4 | Describe sampling theorem and pulse modulation techniques. |
| CO5 | Identify Line Coding & channel coding techniques. |
| CO6 | Discuss different types of digital modulation techniques. |

**Course Contents:**

**UNIT I** **[07 Hours]**

**Amplitude Modulation:**

Introduction of amplitude modulation, Equation of AM, Generation of AM (DSBFC) and its spectrum, Modulation Index, Power relations applied to sinusoidal signals.

DSBSC – multiplier modulator, Nonlinear generation, switching modulator, Ring modulator & its spectrum, SSBSC, ISB & VSB Comparison, AM Broadcast technical standards.

**UNIT II** **[07 Hours]**

**Angle Modulation:**

Concept of Angle modulation: Types of Angle Modulation, frequency spectrum, Narrow band & wide band FM, Modulation index, Bandwidth. Bessel's Function and its mathematical analysis, Generation of FM (Direct & Indirect Method), Comparison of FM and PM.

**UNIT III** **[07 Hours]**

**AM and FM Receivers:**

Super heterodyne Receiver, Performance characteristics: Sensitivity, Selectivity, Fidelity, Image Frequency Rejection.

AM Detection: Rectifier detection, Envelope detection ,FM Detection: Foster Seelay FM Detector & FM detection using PLL.

**UNIT IV** **[08 Hours]**

**Pulse Modulation:**

Sampling theorem in time domain, Nyquist criteria, Types of sampling- ideal, natural, flat top, Aliasing & Aperture effect.

Pulse modulation Techniques: PAM PWM & PPM. PCM – Generation & reconstruction, Bandwidth requirement of PCM, Introduction to Delta Modulation & Adaptive DM.

**UNIT V** **[08 Hours]**

**Line coding & Channel Coding:**

Classification of Line Codes, Unipolar-RZ, RZ, NRZ-I, NRZ-L, Polar-NRZ and RZ, Bipolar NRZ and RZ. Channel coding techniques: Review of channel coding, Linear block codes, Cyclic codes, Hamming Code, Convolutional codes and Decoding Techniques.

**UNIT VI** **[08 Hours]**

**Digital Communication Systems:**

Communication Channel Characteristics, Digital modulation techniques: ASK, FSK, PSK, QPSK, QAM, MSK, OFDM.

**Suggested Self Readings:**

**Text Books**


| | |
|---|---|
| 1. | Kennedy & Devis : Electronic Communication Systems , Tata McGraw Hills |
| 2. | Publication(Fourth Edition) |
| 3. | Dennis Roddy & Coolen - Electronic Communication, PHI (Fourth Edition) |

| | |
|---|---|
| 4. | B. P. Lathi: Modern Digital and Analog. Communication Systems: Oxford Press Publication (Third Edition) |
| 5. | John G Prokis, Digital communication 4 th edition Date:2005,TMG |
| | |
| **Reference Books** | |
| 1. | Simon Haykin: Communication Systems, John Wiley & Sons, Fourth Edition |
| 2. | Taub & Schilling: Principles of Communication Systems, Tata McGraw-Hill |
| 3. | B.P. Lathi, Modern Digital & Analog Communication Systems,4th editionDate: 2009, |
| 4. | Abhay Gandhi, Analog and Digital Communications: Theory and Lab Work;1st Edition, |

**Fourth Semester**

| | |
|---|---|
| **Course Title: Analog & Digital Communication Lab** | |
| **Course Code: 24UEC402P** | **Course Category: PCC** |
| **Teaching Scheme: L – T – P** | **Total Credits:** 01 |
| **0 - 0 - 2** | **Semester:** IV |
| **Scheme of Examination: ESE: 25 Mks, CE: 25 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Perform practical based on analog and digital modulation techniques. |
| 2. | Make them study the analysis of AM and FM receivers. |
| 3. | Enable to understand ASK, FSK and PSK techniques. |
| 4. | Explore MATLAB based practical for different modulation techniques. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Demonstrate different modulation techniques used in Electroniccommunication system. |
| CO2 | Use the modulation techniques and modern communication toolsnecessary for various engineering applications. |
| CO3 | Evaluate fundamental communication system parameters, such asbandwidth power, signal to quantization noise ratio, data rate etc. |

| Sr. No. | **List of Experiments** |
|---|---|
| 1. | To generate Amplitude Modulated wave using different techniques and |
| 2. | plot its waveform. |
| 3. | To generate Frequency Modulated wave using different techniques andplot its waveform. |
| 4. | To generate Pulse Amplitude Modulation (PAM) and plot the waveforms.Observe the |
| 5. | To generate |
| 6. | To generate Pulse Position modulated signal and study Pulse PositionDemodulation. |
| 7. | To generate DSB-SC signal using balanced modulator |
| 8. | To draw Spectrum Analysis of AM & FM signals |

| | |
|---|---|
| 9. | To observe the Input and Output waveforms of Digital Modulation Techniques ASK, FSK, PSK |
| 10. | To generate AM Modulated signal using simulation software. |
| 11. | To generate FM modulated signal using simulation software. |
| 12. | To generate PM modulated signal using simulation software. |

**Fourth Semester**

| | |
|---|---|
| **Course Title: Signals and Systems** | |
| **Course Code: 24UEC403T** | **Course Category: PCC** |
| **Teaching Scheme: L – T – P** | **Total Credits: 03** |
| **3 – 0 – 0** | **Semester: IV** |
| **Scheme of Examination: ESE: 60 Mks, CE: 40 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Introduce students to basic definitions and classification of Signals and Systems and their operations. |
| 2. | Give an understanding of the concept of sampling and signal reconstruction. |
| 3. | Make them understand the concept of Linear Shift Invariant Systems and responses of the system for various |
| 4. | Enable them to perform system analysis using Fourier and Laplace Transforms. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Classify different signals and systems and perform basic signal operations. |
| CO2 | Explain the concept of sampling and reconstruction of analog signals. |
| CO3 | Evaluate impulse response, step response, convolution, and characteristics of LSI systems. |
| CO4 | Analyze Systems using Fourier analysis and synthesis of continuous-time signals . |
| CO5 | Perform Laplace analysis of system using Laplace Transform. |
| CO6 | Compare distortions in Systems and perform noise analysis |

**Course Contents:**

**UNIT I** **[08 Hours]**

**Introduction to signals and Systems:**

Representation of signals, Signal classification, Types of signals, Operations on signals - Scaling, Shifting, Transformation of independent variables.

Classification of systems - Static and dynamic, Linear and non-linear, Time-variant and time-invariant, Causal and non-causal, Stable and unstable.

**UNIT II** **[07 Hours]**

**Sampling Theorem and its Implications:**

Sampling theorem in time domain and Frequency domain, TDM and FDM concept, Oversampling, Under sampling, Aliasing Effect and its Solution, zero order hold sampling, first Order hold sampling, Natural Sampling, Flat Top Sampling, Quantization, Quantization Error.

**UNIT III** **[07 Hours]**

**Linear shift Invariant Systems:**

Impulse response and step response of systems, Convolution, System representation using difference and differential equations, Input Output behaviour of the system with periodic and aperiodic convergent inputs.

**UNIT IV** **[10 Hours]**

**Fourier Analysis of Signals:**

Introduction to Fourier series, Dirichlet's condition for convergence of Fourier Series, Continuous-time Fourier transform (CTFT), Magnitude and phase response, Properties of Fourier Transform, Parseval's theorem, Inverse Fourier transform, Discrete-time Fourier transform (DTFT), Comparison between CTFT and DTFT.

**UNIT V** **[07 Hours]**

**System Analysis using Laplace transform:**

Laplace Transform: Review of Laplace transforms, Inverse Laplace transform, Poles and Zeros of the system, Concept of region of convergence (ROC) for Laplace transforms, Properties of Laplace Transform, Relation between Laplace transform and Fourier Transform.

**UNIT VI** **[06 Hours]**

Ideal Distortion less channel, Types of distortions- Amplitude, Frequency, Phase, Noise, Signal to Noise ratio, nonlinear behaviour of signals, Noise Figure, Effects of frequency and phase mismatch.

**Suggested Self Readings:**

**Text Books**


| | |
|---|---|
| 1. | Simon Haykin and Barry VanVeen, Signals and systems, 2007, second edition, Wiley, |
| 2. | Alan. V. Oppenheim, Alan. S. Willsk, S. Hamid Nawab, Signals and systems, 2001, second edition- PHI learning Pvt. ltd. |
| 3. | A Nagoor kani, Signals and Systems, Second reprint, 2010, Tata Mcgrawhill. |

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|---|---|
| | |
| **Reference Books** | |
| 1. | B. P. Lathi, Signal processing and linear systems, 2009, Oxford university press. |
| 2. | B.P.Lathi, Modern Digital & Analog Communication Systems,4th edition, |

**Fourth Semester**

| | |
|---|---|
| **Course Title: IoT Tools Lab** | |
| **Course Code: 24UEC404P** | **Course Category: PCC** |
| **Teaching Scheme: L – T – P** | **Total Credits:** 01 |
| **0 - 0 – 2** | **Semester:** IV |
| **Scheme of Examination: ESE: 25 Mks, CE: 25 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Familiarise them with various types of Arduino boards with their features. |
| 2. | Enable them to learn Arduino programming concepts and Arduino IDE. |
| 3. | Equip with knowledge of the interfacing of various devices like Sensors, display, switches, and motors, wireless connectivity devices like Zigbee, Wi-Fi modules. |
| 4. | Make them learn analog to digital conversion features of Arduino. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have the ability to: | |
| CO1 | Identify various Arduino Boards and their features and utility for variousapplications. |
| CO2 | Design and implement interfacing of various devices with Arduino. |
| CO3 | Apply the analog to digital conversion feature of Arduino and develop related applications. |
| CO4 | Interface Wireless devices with Arduino. |

**Course Contents:**

| **Basic Topics** |
|---|
| Study of Arduino Boards, Pin description of Arduino board and Arduino IDE. Arduino IDE installation<br>Arduino Interfacing with LED, Seven Segment Displays, Push Button Switches<br>Arduino Interfacing with LCD, OLED for image display.<br>Arduino Interfacing with various sensors like PIR, IR, Ultrasonic sensors etc. Arduino programming to generate PWM wave and to control speed/direction of DC motor, Brightness control of LED.<br>Analog to digital conversion using Arduino.<br>Arduino Interfacing with Zigbee, ESP 8266 wi-fi module. |

| Advanced topics |
|---|
| Realization of basic logic gates using Arduino. C programming using AVR- GCC compiler Assembly and C mix programming on Arduino. |

| Sr. No. | List of Experiments |
|---|---|
| 1. | Study of Arduino Board and installation of Arduino IDE. |
| 2. | Design a circuit to interface LEDs and generate a flashing pattern using Arduino. |
| 3. | Design a circuit to interface seven segment display and push button switches sw1 to sw7 to the Arduino and display the digit corresponding to pressed switch. |
| 4. | Design a circuit to interface LCD with Arduino and display a Welcome message. |
| 5. | Design a circuit to interface LCD with Arduino and create a rolling display. |
| 6. | Interface OLED with Arduino to display image on it. |
| 7. | Interface Arduino with sensors like motion sensors, Ultrasonic sensors, PIR sensors. |
| 8. | Write a program to generate PWM wave using Arduino to controlbrightness of LED. |
| 9. | Write a program to generate PWM wave using Arduino to controlspeed/direction of DC motor. |
| 10. | Interface Temperature /Humidity sensor with Arduino to read the analogvalues and print those values. |
| 11. | Write a program to read analog values of a sine wave from a functiongenerator and display those values on serial monitor. |
| 12. | Interface Zigbee module with Arduino to transmit the data and receiveand display data on serial monitor of receiver. |
| 13. | Interface ESP 8266 WiFi module to turn on and off LED through amobile/Laptop. |
| 14. | Write an assembly language program to verify the truth table of LogicalAND/OR gate. |
| 15. | Write an AVR GCC program to display a digit on LCD. |
| 16. | Write a mixed Assembly and C program to blink LED using Arduino. |
| 17. | Mini Project- Any application development using Arduino Board. |

| Suggested Self Readings: | |
|---|---|
| **Text Books** | |
| 1. | Arun Palanisamy, Fundamentals of Arduino, Xpress Publishing, First Edition |
| 2. | Aryan Kurkure, Learning Arduino in 2 months-Coding Made Easy, NotionPress |
| | |

| Reference Books/Link | |
|---|---|
| 1. | **https://onlinecourses.swayam2.ac.in/aic20_sp04** |
| 2. | https://forum.arduino.cc/t/programming-xbee-to-transmit-and-receive- data/224613/15 |
| 3. | https://www.arduino.cc |

**Fourth Semester**

| **Course Title: Object Oriented Programming Lab** | |
|---|---|
| **Course Code: 24UCT407P** | **Course Category: MDM** |
| **Teaching Scheme: L – T – P** | **Total Credits:** 02 |
| **0 – 1 – 2** | **Semester:** IV |
| **Scheme of Examination: ESE: 25 Mks, CE: 25 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Enable students with basics of Object Oriented Programming cocepts. |
| 2. | Equip them with concepts of Inheritance, Polymorphism and Interfaces in problem-solving. |
| 3. | Provide them with the concepts of Exception Handling |
| 4. | Make them to explore program using file system. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Demonstrate the basic concepts of Object Oriented Programming and design simple java |
| CO2 | Apply the knowledge of Inheritance, polymorphism and interfaces in program development. |
| CO3 | Implement various exceptions using concepts of exception handling and file streaming and GUI based applications. |

**Course Contents:**

| **Basic Topics** |
|---|
| Control Statements – If, else, nested if, if-else ladders, Switch, while, do-while,for for-each, break, continue, Methods.<br>Class, Object, Object reference, Constructor, Constructor Overloading, Method Overloading, Recursion.<br>Inheritance and Polymorphism.<br>Interfaces and Packages.<br>Exception Handling and I/O Streams.<br>GUI components in Java.<br>Introduction to Database Connectivity. |

| Sr. No. | **List of Experiments** |
|---|---|
| 1. | Develop programs to demonstrate use different forms of if statements and its different forms. |
| 2. | Develop programs to demonstrate use of. Looping statement i.e. 'For','while', 'do-while' |
| 3. | Develop programs to demonstrate concept of Class and Object. |
| 4. | Develop programs for implementation of single and multilevelinheritance. |
| 5. | Write a program to implement the concept of overloading. |
| 6. | Write a program to implement the concept of overriding. |
| 7. | Develop a program to implement the try, catch and finally block. |
| 8. | Develop a program for implementation of File stream classes. |
| 9. | Develop a program to perform push and pop operation on stack andperform insert and delete |
| 10. | Develop a program to perform operation on linked list. |
| 11. | Develop a program to implement graphs in java. |
| 12. | Develop a program to implement spanning trees. |

| **Suggested Self Readings:** | |
|---|---|
| **Text Books** | |
| 1. | Herbert Scheldt, "Java the complete reference", McGraw Hill, Osborne, 7th Edition, 2011. |
| 2. | T. Budd, "Understanding Object- Oriented Programming with Java", Pearson Education, Updated Edition (New Java 2 Coverage), 1999. |

**Fourth Semester**

| | |
|---|---|
| **Course Title: Mechatronics** | |
| **Course Code: 24UOE441T** | **Course Category: OE** |
| **Teaching Scheme: L – T – P** | **Total Credits: 02** |
| **2 – 0 – 0** | **Semester:** IV |
| **Scheme of Examination: ESE: 30 Mks, CE: 20 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | To understand the working of mechatronics systems. |
| 2. | To acquire the insight to build the mechatronics systems. |
| 3. | To make understanding of various control systems. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Identify various inputs and output devices in an automated system |
| CO2 | Understand and draw ladder diagrams, |
| CO3 | Implement interfacing of input and output devices |
| CO4 | Identify and describe actuating systems, microprocessors & microcontroller. |

**Course Contents:**

**UNIT I** **[07 Hours]**

**Introduction of Mechatronics System:**

Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of feedback control system.

**UNIT II** **[08 Hours]**

**Sampling Theorem and its Implications:**

Sampling theorem in time domain and Frequency domain, TDM and FDM concept, Oversampling, Undersampling, Aliasing Effect and its Solution, zero order hold sampling, first Order hold sampling, Natural Sampling, Flat Top Sampling, Quantization, Quantization Error.

| **UNIT III** | **[08 Hours]** |
|---|---|

**Electrical Actuating Systems:**

Mechanical switches and relays, solenoids, state switches solenoids, DC Servomotors, Stepper motor, Induction Motors, speed control, pulse four quadrant servo drives, Pulse width modulation (PWM) frequency drive, vector drive. Pneumatics & Hydraulic Actuating Systems: Pneumatics & Hydraulic Systems.

| **UNIT IV** | **[7 Hours]** |
|---|---|

**PLC and SCADA:**

Programmable Logic Controller: Introduction to PLCs, Basic structure of PLC, Principle of operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, Introduction to SCADA: Functionality, applications, development, evaluation and benefits of SCADA.

**Suggested Self Readings:**

**Text Books**

| | |
|---|---|
| 1. | Mechatronics-Integrated |
| 2. | Mechatronics & Microprocessors, K.P. Ramachandran, Wiley India Pvt.Ltd., New Delhi. |
| 3. | Mechatronics, Bolton W, Pearson Education, Second Edition, 1999. |

**Reference Books**

| | |
|---|---|
| 1. | Pneumatic Application, Wemer Deppert and Kurt Stoll, Kemprath Reihe, Vovel Verlag, |
| 2. | Mechatronics, N. P. Mahalik, Mc Graw-Hill Education |
| 3. | Mechatronic Systems Fundamentals, Rolf Isermann, Springer, 2003. |

**Fourth Semester**

| | |
|---|---|
| **Course Title: Internet of Things** | |
| **Course Code: 24UOE442T** | **Course Category: OE** |
| **Teaching Scheme: L – T – P** | **Total Credits: 02** |
| **2 – 0 – 0** | **Semester:** IV |
| **Scheme of Examination: ESE: 30 Mks, CE: 20 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Introduce basic concepts of Internet of things, architectures, Sensing, Actuation. |
| 2. | Enable them with basic communication aspects of IoT like Communication protocols. |
| 3. | Equip them to explore basic concepts of IoT tools like raspberry Pi, Arduino and itsinterfacing. |
| 4. | Give them insight of various applications and case studies of IoT. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Define and state basic terminologies and concepts of IoT. |
| CO2 | Classify various communication models and explain various communication protocols. |
| CO3 | Apply various IoT tools and develop applications using these tools. |
| CO4 | Explain various applications and case studies of IoT. |

**Course Contents:**

**UNIT I** **[08 Hours]**

**Introduction to IoT:**

IoT definition & Characteristics, Advantages and disadvantages, Applications, IoT functional blocks, sensing actuation, IoT Architectures: Three Layer, Four Layer and Five Layer, IoT Vs M2M Communication, IoT Enabling Technologies concepts.

**UNIT II** **[07 Hours]**

**Communication Aspects of IoT:**

IoT Communication Models (Request Response, Publish Subscribe, Push Pull, Exclusive Pair) Application Layer Protocols: HTTP, MQTT, COAP, Transport Layer Protocols: TCP,UDP; Network

Layer Protocols: IPv4, IPv6, 6LowPAN; Link Layer Protocols: Wi-Fi(802.11), Ethernet(802.3), WiMAX (802.16), LR-WPAN(802.15.4), LoRa WAN, Cellular(2G/3G/LTE).

**UNIT III** **[08 Hours]**

**IoT Tools:**

Introduction to Raspberry Pi, Raspbian OS: Basic Features, Installation, Various Raspbian Commands, Introduction to Arduino, Arduino IDE, Introduction to Node MCU ESP 8266, ESP32 Wi-Fi Modules.

**UNIT IV** **[07 Hours]**

**IoT Applications:**

Introduction to Edge computing, Cloud computing and Fog computing.

Case Studies: Home Automation, Health Monitoring, Agriculture. Python Programming for IoT applications.

**Suggested Self Readings:**

**Text Books**


| | |
|---|---|
| 1. | Satish Jain, Shashi Singh; IoT and its Applications; bpb publications |
| 2. | Arshdeep Bahga, Vijay Madisetti, Internet of Things-A Hands onApproach; University Press |
| 3. | Dieter Uckleman, Mark Harrison et.al.; Architecting the Internet ofThings; Springer Publications. |


**Reference Books**


| | |
|---|---|
| 1. | https://nptel.ac.in/courses/106105166 |

**Fourth Semester**

| | |
|---|---|
| **Course Title: Industrial Applications of Raspberry Pi** | |
| **Course Code: 24UOE443T** | **Course Category: OE** |
| **Teaching Scheme: L – T – P** | **Total Credits: 02** |
| **2 – 0 – 0** | **Semester:** IV |
| **Scheme of Examination: ESE: 30 Mks, CE: 20 Mks** | |
| **Prerequisites: Knowledge of fundamentals of Microprocessors.** | |

| **Course Objectives:** | |
|---|---|
| 1. | To understand basics of Raspberry Pi and Raspbian OS. |
| 2. | To Understand basic python programming concepts for programming Raspberry Pi. |
| 3. | To study interfacing of various Hardware like sensors, actuators, camera with Raspberry Pi. |
| 4. | To understand industrial applications of Raspberry Pi. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Classify various Raspberry Pi boards and state their configurations, pin descriptions. |
| CO2 | Use various Raspbian OS commands and programming concepts of Python for |
| CO3 | Interface various sensors and actuators with Raspberry Pi and send data oncloud |
| CO4 | Classify IoT, IIoT and Industry 4.0 and discuss applications of Raspberry Pi. |

**Course Contents:**

**UNIT I** **[07 Hours]**

**Getting Started with Raspberry Pi:**

Various Raspberry Pi Boards and their configuration, Basic blocks of Raspberry Pi, Pin configuration of Raspberry Pi, Raspbian OS, Installation and Setup, Raspbian OS Commands.

**UNIT II** **[08 Hours]**

**Python Programming for Raspberry Pi:**

Python programming for Raspberry Pi, Python Programming Environment, Python Expressions, Strings, Functions and Function arguments, Lists, List Methods, Control Flow, Python programming for data Communication.

| **UNIT III** | **[07 Hours]** |
|---|---|

**Hardware Interfacing with Raspberry Pi:**

Interfacing with LED, Raspberry Pi Camera interfacing and image capturing, Interfacing with Temperature and humidity sensor (DHT11 and DHT22), Interfacing with RFID module, Relays, Sending Data using IOT.

| **UNIT IV** | **[08 Hours]** |
|---|---|

**Industrial Applications:**

Introduction to IoT, Relation between IoT, IoT and Industry 4.0.

Case Study: Smart Factories, Healthcare Service Industry, Transportation and Logistics, Mining, Firefighting and Disaster management, Milk Processing and Packaging industry.

**Suggested Self Readings:**

| | **Text Books** |
|---|---|
| 1. | Ioana Culic, Alexandru Radovici, Cristian Rusu; Commercial and Industrial Internet of Things Applications with the Raspberry Pi: Prototyping IoT Solutions; Apress Publications. |
| 2. | Arshdeep Bahga, Vijay Madisetti, Internet of Things-A Hands onApproach;University Press |
| | |
| | **Reference Books** |
| 1. | https://nptel.ac.in/courses/106105166 |
| 2. | https://onlinecourses.nptel.ac.in/noc20_cs69 |
| 3. | https://freevideolectures.com/course/4231/nptel-introduction-industry-industrial-internetthings/59 |

Lokmanya Tilak Jankalyan Shikshan Sanstha's
PRIYADARSHINI COLLEGE OF ENGINEERING, NAGPUR
(An Autonomous Institute affiliated to Rashtrasant Tukadoji Maharaj Nagpur Unive
Electronics and Communication Engineering
Fourth Semester

| | |
|---|---|
| **Course Title: Professional communication** | |
| **Course Code: 24UBS407T** | **Course Category: AEC** |
| **Teaching Scheme: L – T – P** | **Total Credits: 02** |
| **2 – 0 – 0** | **Semester:** IV |
| **Scheme of Examination: ESE: 30 Mks, CE: 20 Mks** | |
| **Prerequisites: Basic knowledge of spoken and written English** | |

| **Course Objectives:** | |
|---|---|
| 1. | Students would be able to enhance their language skills and be prepared for placements. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Construct correct sentences for spoken and written English. |
| CO2 | Develop writing and speaking skills. |
| CO3 | Demonstrate writing skills at work place. |
| CO4 | Prepare themselves for job placement. |

**Course Contents:**

**UNIT I** **[07 Hours]**

**Grammar for Spoken English:**

Tense, Active and Passive Voice, Negative, Interrogative and Negative-interrogative sentences, use of modal auxiliary verbs, reinforcement exercises

**UNIT II** **[08 Hours]**

**Writing and Speaking skills:**

Paragraph writing, Research papers writing, role play exercises for speaking (at shop, restaurant, bank, airport, office etc.), Public speaking, reinforcement exercises .

**UNIT III** **[08 Hours]**

**Professional writing skills:**

Business letters, email, minutes of meeting, notices, circulars, memos, blog writing, virtual message drafting, one page report writing.

| **UNIT IV** | **[07 Hours]** |
|---|---|

**Job placement techniques:**

Job application letter, Resume writing, Group discussion, types of interviews, interview techniques, telephonic interview etiquettes.

**Suggested Self Readings:**

| **Text Books** | |
|---|---|
| 1. | Technical Communication by Meenakshi Raman and Sangeeta Sharma, OUP Solutions; Apress Publications. |
| 2. | Public Speaking and Influencing Men in Business by Dale Carnegie |
| 3. | Professional Communication Skills by Bhatia and Sheikh, S. Chand Publications |
| 4. | Communication Skills by Sanjeev Kumar and Pushpalata, OUP |
| 5. | Functional English for Technical Students by Dr. Pratibha Mahato and Dr. Dora Thompson, Himalaya Publishing House. |
| 6. | Communication Skills by Lalita Bisen, Bhumika Agrawal, N. Thejo Kalyani, Himalaya Publishing House. |

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Electronics and Communication Engineering
Fourth Semester

| | |
|---|---|
| **Course Title: Environmental Science** | |
| **Course Code: 24UBS410T** | **Course Category: VEC** |
| **Teaching Scheme: L – T – P** | **Total Credits: 02** |
| **2 – 0 – 0** | **Semester:** IV |
| **Scheme of Examination: ESE: 30 Mks, CE: 20 Mks** | |
| **Prerequisites: Students are expected to know the fundamental principles of theoretical and experimental Basic Science of HSC level.** | |

| **Course Objectives:** | |
|---|---|
| 1. | A Systematic study of Human Interaction with the environment in the interest of solving complex problems |
| 2. | Study of physical and biological characters of the environment and also the social and cultural factors along with the impact of man on environment. |
| 3. | Bring together the principles of various disciplines of sciences to solve contemporary environmental problems. |

| **Course Outcomes:** | |
|---|---|
| At the end of this course, students will have an ability to: | |
| CO1 | Recognize the Multidisciplinary nature of environmental science and gain in- depth knowledge of natural processes that sustain life and govern economy. |
| CO2 | Develop critical thinking for shaping strategies (scientific, social, economicand legal) for environmental protection and conservation of biodiversity, social equity and sustainable development. |
| CO3 | Acquire values and attitudes towards understanding complex environmental-economic-social challenges, and participating actively in solving current environmental problems and preventing the future ones. |
| CO4 | Adopt sustainability as a practice in life, society and industry and know their roles and ethics, as citizens, and consumers in a complex, interconnected world. |

**Course Contents:**

**UNIT I** **[06 Hours]**

**Environment as an interdisciplinary subject and Natural resources:**

Environment: Definition, Scope, basic terms, importance, need for public awareness. concept of sustainable development. Natural resources and associated problems. Forest, water, mineral, food and land resources. Role of individuals in conservation of natural resources. Equitable use of resources for sustainable lifestyle. Environmental Application of remote sensing and GIS. Relevant case studies, laws and Legislations.

**UNIT II** **[08 Hours]**

**Ecosystem and Biodiversity:**

Ecosystem: Concept, Structure and Functions, Energy Flow, Food Chain, Food web, and Ecological Pyramids; Grassland and pond Ecosystem. Ecological succession.

Biodiversity: Introduction, definition, Types (genetic, species & ecosystem). value of biodiversity, Biodiversity at Global, National and local Levels. Hot spots of biodiversity; Threats to biodiversity; conservation, In-situ and Ex-situ conservation; Relevant case studies, laws and Legislations.

**UNIT III** **[08 Hours]**

**Environmental Pollution, hazards, Disaster management & EIA:**

Pollution: Definition, causes, effects and control measures of Water, Air, solid, noise and nuclear pollution. Environmental hazards & Disaster management: Definition, and types of mitigation. Preparedness and awareness. Environmental impact assessment (EIA); scope, importance and need. Role of IT in environment. Environmental Auditing; Relevant case studies, laws and Legislations.

**UNIT IV** **[08 Hours]**

**Social Issues and Environment, Environmental conventions:**

Population explosion, Urban problems related to energy, resettlement and rehabilitation of people, their problems and concerns, family welfare program, human health, women and child welfare; environmental ethics & consumerism. Mass tourism and environment. Sustainable tourism. Stockholm convention, Kyoto Protocol, Montreal Protocol, COP (Conference of Parties), Ramsar Convention, Rio Summit, Convention on Biological Diversity; National Green Tribunal; Relevant case studies, laws and Legislations.

**Suggested Self Readings:**

**Text Books**


| | |
|---|---|
| 1. | Environmental Pollution control engineering ISBN-978-93-86649-89-8 |
| 2. | Environmental Studies ISBN-978-81-317-2118-6 |
| 3. | Environmental Studies Univ. Sci. Press ISBN-978-81-318-0641-8. |
| 4. | Environmental Studies: ISBN: 8188458-77-5 |

| Course Title: Introduction to Artificial Intelligence | |
|---|---|
| **Course Code: 24UHSEC4T** | **Course Category: Honors** |
| **Teaching Scheme: L – T – P** | **Total Credits: 03** |
| **3 – 0 – 0** | |
| **Scheme of Examination: ESE: 60 Mks, CE: 40 Mks** | |

**Prerequisites:**

1. **Fundamental knowledge of discrete mathematics and logic.**
2. **Understanding of probability and statistics.**
3. **Familiarity with data structures and algorithms.**

| **Course Objectives:** | |
|---|---|
| **1.** | Introduce the fundamental concepts of Artificial Intelligence, including intelligent agents, problem-solving, and search strategies. |
| **2.** | Equip students with advanced knowledge of adversarial search, knowledge representation, reasoning, and planning techniques for AI applications. |
| **3.** | Develop an understanding of uncertainty in AI, probabilistic reasoning, and machine learning algorithms for decision-making. |
| **4.** | Explore the applications of AI in natural language processing, robotics, and computer vision. |
| **5.** | Familiarize students with AI ethics, challenges, and real-world AI applications in various domains. |
| **6** | Enable students to implement AI algorithms and develop AI-based solutions using appropriate tools and frameworks. |

| **Course Outcomes:** | |
|---|---|
| **At the end of this course, students will have the ability to:** | |
| **CO1** | Formulate and solve real-world problems using search algorithms and AI-based problem-solving techniques. |
| **CO2** | Analyze and implement adversarial search strategies, knowledge representation systems, and AI planning methods. |
| **CO3** | Apply probabilistic reasoning, Bayesian networks, and machine-learning techniques to deal with uncertainty in AI. |
| **CO4** | Demonstrate the ability to work with AI applications like natural language |
| **CO5** | processing and robotics for perception and decision-making. |
| **CO6** | Evaluate the ethical and societal impacts of AI technologies, including bias, fairness and accountability. |

**Course Contents:**

UNIT I [07 Hours]

**Introduction to Artificial Intelligence**:
Definition and history of AI, Intelligent agents: types, structures, and environments, Rationality and the nature of AI environments.

UNIT II [08 Hours]

**Problem-Solving and Search Strategies:**
Problem formulation, Uninformed search algorithms: BFS, DFS, DLS, IDS, Informed search algorithms: A*, Greedy search, Heuristic functions

UNIT III [08 Hours]

**Adversarial Search and Knowledge Representation:**
Game playing, minimax algorithm, alpha-beta pruning, Propositional and first-order logic, Rule-based systems and inference mechanisms

UNIT IV [07 Hours]

**AI Planning and Decision Making:**
Search-based and logic-based planning, Classical planning and STRIPS representation, Markov Decision Processes (MDPs) and Reinforcement Learning.

UNIT V [08 Hours]

**Machine Learning and Uncertainty in AI:**
Probabilistic reasoning and Bayesian networks, Supervised learning: Decision trees, Neural Networks, SVM, Unsupervised learning: Clustering algorithms.

UNIT VI [08 Hours]

**Advanced AI Applications :**
Natural Language Processing: Language models, Parsing, Sentiment analysis, Robotics and Computer Vision: Object detection, Sensor integration, AI Ethics and Future Trends

**Suggested Self Readings:**

**Text Books**

| | |
|---|---|
| **1.** | Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall, Third Edition (2009) (required). |

**Reference Books**

| | |
|---|---|
| **1.** | Ian Goodfellow, Yoshua Bengio & Aaron Courville, Deep Learning, MIT Press (2016). |
| **2.** | Elaine Rich & Kevin Knight, "Artificial Intelligence," McGraw-Hill (Third Edition). |
| **3.** | Tom Mitchell, "Machine Learning," McGraw-Hill (1997). |
| **4.** | Christopher M. Bishop, "Pattern Recognition and Machine Learning," Springer (2006). |

| Course Title: Introduction to Artificial Intelligence Practical | |
|---|---|
| **Course Code: 24UHSEC4P** | **Course Category: Honours** |
| **Teaching Scheme: L – T – P** | **Total Credits: 01** |
| **0– 0– 2** | **Semester: IV** |
| **Prerequisites: Programming Knowledge of Python** | |
| **Scheme of Examination: ESE: 25 Mks, CE: 25 Mks** | |

| **Course Objectives:** | |
|---|---|
| 1. | Understand the general idea of Artificial Intelligence |
| 2. | Develop skills to understand the creation of objects and the interaction between them. |
| 3. | Develop skills required for the creation of various puzzle problem. |
| **Course Outcomes:** | |
| At the end of this course, students will have an ability to: | |
| CO1 | Acquire Knowledge of Applications of AI, Production systems, Real world problem. |
| CO2 | To understand uniform search strategies like BFS, DFS and problem reduction. |
| CO3 | Analyse the Issues in knowledge representation and resolution method in propositional logic. |
| CO4 | To learn Structural Knowledge Representation and Transition networks |
| CO5 | To understand the Knowledge acquisition methods, knowledge engineering process and expert system. |
| **List of Experiments** | |
| 1 | Write a Program to Implement a Breadth-First Search. |
| 2 | Write a Program to Implement Depth First Search |
| 3 | Write a program to implement Hill Climbing Algorithm |
| 4 | Write a program to implement A* Algorithm |
| 5 | Write a program to implement the Tic-Tac-Toe game |
| 6 | Implementation of Python basic Libraries such as Math, Numpy and Scipy |
| 7 | Implementation of Python Libraries for ML applications such as Pandas and Matplotlib |
| 8 | Creation and Loading of different datasets in Python. |
| 9 | Write a Python program to compute the Mean, Median, Mode, Variance and Standard Deviation using Datasets |
| 10 | Implementation of Find S Algorithm |
| 11 | Implementation of Candidate Elimination Algorithm |
| 12 | Write a program to implement simple Linear Regression and Plot the graph |
| 13 | Write a program to implement the Tower of Hanoi Problem |
| 14 | Write a program for travelling salesman problem |