**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**(Established by Govt. of A.P., ACT No.30 of 2008)**

**ANANTAPUR – 515 002 (A.P) INDIA**

**B.TECH. - ELECTRONICS & COMMUNICATION ENGINEERING**

**Course Structure (R20) – III & IV Year**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Semester–V** | | | | | | |
| **S.No.** | **Course Code** | **Course Name** | **L** | **T** | **P** | **Credits** |
| **1.** | 20A04501 | Control Systems Engineering | 3 | 0 | 0 | 3 |
| **2.** | 20A04502T | Digital Signal Processing | 3 | 0 | 0 | 3 |
| **3.** | 20A04503T | Microprocessors and Microcontrollers | 3 | 0 | 0 | 3 |
| **4.** | 20A05602T  20A04504a  20A04504b | **Professional Elective Course – I**  Machine Learning  Computer Architecture & Organization  Information Theory and Coding | 3 | 0 | 0 | 3 |
| **5.** |  | **Open Elective Course – I** | 3 | 0 | 0 | 3 |
| **6.** | 20A04502P | Digital Signal Processing Lab | 0 | 0 | 3 | 1.5 |
| **7.** | 20A04503P | Microprocessors and Microcontrollers Lab | 0 | 0 | 3 | 1.5 |
| **8.** | 20A04506 | **Skill oriented course - III**  PCB Design and Prototype development | 1 | 0 | 2 | 2 |
| **9.** | 20A04507 | Evaluation of Community Service Project |  |  |  | 1.5 |
| **Total** | | | | | | **21.5** |

**Open Elective Course – I**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Course Code** | **Course Name** | **Offered by the Dept.** |
| 1 | 20A01505 | Building Technology | CE |
| 2 | 20A02505 | Electric Vehicles | EEE |
| 3 | 20A03505 | 3D Printing Technology | ME |
| 4 | 20A05505a | Java Programming | CSE & Allied/IT |
|  | 20A05602T | Artificial Intelligence |
| 6 | 20A12502 | Mobile Application Development using Android |
| 7 | 20A27505 | Computer Applications in Food Processing | FT |
| 8 | 20A54501 | Optimization Techniques | Mathematics |
| 9 | 20A56501 | Materials Characterization Techniques | Physics |
| 10 | 20A51501 | Chemistry of Energy Materials | Chemistry |

**Note:**

1. A student is permitted to register for Honours or a Minor in IV semester after the results of III Semester are declared and students may be allowed to take maximum two subjects per semester pertaining to their Minor from V Semester onwards.

2. A student shall not be permitted to take courses as Open Electives/Minor/Honours with content substantially equivalent to the courses pursued in the student's primary major.

3. A student is permitted to select a Minor program only if the institution is already offering a Major degree program in that discipline

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| **Semester–VI**  **Semester-VI** | | | | | | |
| **S.No** | **Course Code** | **Course Name** | **L** | **T** | **P** | **Credits** |
| **1.** | 20A04601T | Antennas & Microwave Engineering | 3 | 0 | 0 | 3 |
| **2.** | 20A04602T | VLSI Design | 3 | 0 | 0 | 3 |
| **3.** | 20A04603T | Communication Networks | 3 | 0 | 0 | 3 |
| **4.** | 20A04604a  20A04604b  20A04604c | **Professional Elective Course– II**  Electronic Measurements and Instrumentation  Embedded System Design  Optical Communications | 3 | 0 | 0 | 3 |
| **5.** |  | **Open Elective – II** | 3 | 0 | 0 | 3 |
| **6.** | 20A04601P | Antennas & Microwave Engineering Lab | 0 | 0 | 3 | 1.5 |
| **7.** | 20A04602P | VLSI Design Lab | 0 | 0 | 3 | 1.5 |
| **8.** | 20A04603P | Communication Networks Lab | 0 | 0 | 3 | 1.5 |
| **9.** | 20A04606 | **Skill oriented course - IV**  RFRF System Design | 1 | 0 | 2 | 2 |
| **10.** | 20A99601 | **Mandatory Non-credit Course**  Intellectual Property Rights & Patents | 2 | 0 | 0 | 0 |
| **Total** | | | | | | **21.5** |
| Industry Internship (Mandatory) for 6 - 8 weeks duration during summer vacation  Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also) 4 0 0 4 | | | | | | |

**Open Elective Course – II**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No.** | **CourseCode** | **Course Name** | **Offered by the Dept.** |
| 1 | 20A01704 | Environmental Economics | CE |
| 2 | 20A02605 | Smart Electric Grid | EEE |
| 3 | 20A03605 | Non-Conventional sources of energy | ME |
| 4 | 20A05605a | Principles of Operating Systems | CSE & Allied/IT |
| 6 | 20A05605b  b | Foundations of Machine Learning  Oundations of Machin |
| 7 | 20A05605c | Data Analytics Using R |
| 8 | 20A27605 | Food Refrigeration and Cold Chain Management | FT |
| 9 | 20A54701 | Wavelet Transforms & its applications | Mathematics |
| 10 | 20A56701 | Physics Of Electronic Materials and Devices | Physics |
| 11 | 20A51701 | Chemistry of Polymers and its Applications | Chemistry |

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| **Semester-VII** | | | | | | |
| **S.No.** | **Course Code** | **Course Name** | **L** | T | **P** | **Credits** |
| **1.** | 20A04701a  20A04701b  20A04701c | **Professional Elective Course– III**  DSP Processors & Architectures  Introduction to Internet of Things  Satellite Communications | 3 | 0 | 0 | 3 |
| **2.** | 20A04702a  20A04702b  20A04702c | **Professional Elective Course– IV**  Real Time Operating Systems  Digital Image Processing  Radar Engineering | 3 | 0 | 0 | 3 |
| **3.** | 20A04703a  20A05703b  20A04703c | **Professional Elective Course– V**  Smart Sensors  Nano Electronics  Cellular & Mobile Communications | 3 | 0 | 0 | 3 |
| **4.** | 20A52701a  20A52701b 20A52701c | **Humanities Elective – II**  Entrepreneurship and Incubation  Management Science  Enterprise Resource Planning | 3 | 0 | 0 | 3 |
| **5.** |  | **Open Elective Course – III** | 3 | 0 | 0 | 3 |
| **6.** |  | **Open Elective Course – IV** | 3 | 0 | 0 | 3 |
| **7.** | 20A04706 | **Skill oriented course – V**  Industrial IoT & Automation | 1 | 0 | 2 | 2 |
| **8.** | 20A04707 | Evaluation of Industry Internship |  |  |  | 3 |
| **Total** | | | | | | **23** |

**Open Elective Course – III**

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Course Code** | **Course Name** | **Offered by the Dept.** |
| 1 | 20A01705 | Cost Effective Housing Techniques | CE |
| 2 | 20A02704 | IOT Applications in Electrical Engineering | EEE |
| 3 | 20A03704 | Introduction to Hybrid and Electric Vehicles | ME |
| 4 | 20A05704a | Web Technologies | CSE & Allied/IT |
| 5 | 20A05704b | VR & AR for Engineers |
| 6 | 20A05704c | Software Engineering |
| 8 | 20A27704 | Human Nutrition | FT |
| 9 | 20A54702 | Numerical Methods for Engineers | Mathematics |
| 10 | 20A56702 | Sensors And Actuators for Engineering Applications | Physics |
| 11 | 20A51702 | Chemistry of Nanomaterials and Applications | Chemistry |

**Open Elective Course – IV**

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| --- | --- | --- | --- |
| **S.No** | **Course Code** | **Course Name** | **Offered by the Dept.** |
| 1 | 20A01706 | Health, Safety & Environmental management | CE |
| 2 | 20A02705 | Renewable Energy Systems | EEE |
| 3 | 20A03705 | Introduction to Composite Materials | ME |
| 4 | 20A05705a | Cyber Security | CSE & Allied/IT |
| 5 | 20A05705b | Introduction to Full Stack Development |
| 7 | 20A27705 | Waste and Effluent Management | FT |
| 8 | 20A54703 | Number theory & its applications | Mathematics |
| 9 | 20A56703 | Smart Materials and Devices | Physics |
| 10 | 20A51703 | Green Chemistry and Catalysis for Sustainable Environment | Chemistry |

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| **Semester-VIII** | | | | | | | |
| **S.No.** | **Course Code** | **Course Name** | **Category** | **L** | T | **P** | **Credits** |
| **1.** | 20A04801 | Full Internship & Project work | PR |  |  |  | 12 |
| **Total** | | | | | | | **12** |

**COURSES OFFERED FOR HONOURS DEGREE IN ECE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Code** | **Course Title** | **Contact Hours per Week** | | **Credits** |
| **L** | **T** |
| 1 | 20A04H01 | Adaptive Signal Processing | 3 | 1 | 4 |
| 2 | 20A04H02 | Software Defined Radio | 3 | 1 | 4 |
| 3 | 20A04H03 | MEMS | 3 | 1 | 4 |
| 4 | 20A04H04 | Low power VLSI Design | 3 | 1 | 4 |
| 5 | 20A04H05 | Wireless Communications | 3 | 1 | 4 |
| 6 | 20A04H06 | Speech Processing | 3 | 1 | 4 |
| **Suggested MOOCs** | | | | | |
| 8. | 20A04107 | VLSI Testing |  | | 2 |
| 9. | 20A04108 | Embedded Software and Hardware Architecture |  | | 2 |

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| **S.No.** | **Minor Title** | **Department offering the Minor** |
| 1. | Construction Technology | Civil Engineering |
| 2. | Environmental Geotechnology | Civil Engineering |
| 3. | Energy Systems | EEE |
| 4. | 3D Printing | ME |
| 5. | Industrial Engineering | ME |
| 6. | Food Science | Food Technology |
| 7. | Artificial Intelligence & Data Science | CSE& Allied/ IT |
| 8. | Virtual & Augmented Reality |
| 9. | Cyber Security and Blockchain Technologies |

**LIST OF MINORS OFFERED TO ECE**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE)– III-I Sem L T P C**

**3 0 0 3**

**(20A04501) CONTROL SYSTEMS ENGINEERING**

**Course Objectives:**

* To introduce concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems and concept of feedback.
* To describe characteristics of the given system in terms of the transfer function.
* To provide knowledge in analyzing the system response in time-domain and frequency domain
* To impart skills for designing different control systems for different applications as per given specifications.
* To introduce concepts of state variable analysis and design.

**Course Outcomes:**

* Identify open and closed loop control system
* Formulate mathematical model for physical systems
* Use standard test signals to identify performance characteristics of first and second-order systems
* Analyze stability of the closed and open loop systems
* Design closed-loop control system to satisfy dynamic performance specifications using frequency response, root-locus, and state-space techniques

**UNIT I Introduction**

Introduction: Overview of System, Control System, Open Loop Control System, Closed loop Control System, Different Examples, Mathematical models of Physical Systems, Differential equations of physical systems, Transfer functions, Block diagram Algebra, Signal flow graphs with illustrative examples Effects of Feedback, Feedback Characteristics and its advantages, Line arising effect of feedback.

**UNIT II Time Response Analysis**

Controller Components, DC Servomotor (Armature Controlled and Field Controlled) with necessary derivation for transfer function, AC Servomotor and its transfer function, AC Tachometer, Potentiometer, Synchros, AC Position Control Systems.

Time Response Analysis, Standard test Signals, Time response of first and second order systems, steady state errors and error constants, Effect of adding a zero to a system, Design specifications of second order systems, Performance indices

**UNIT III Concepts of Stability**

Concepts of Stability and Algebraic Criteria: The concept of Stability, Necessary Conditions for Stability, Routh-Hurwitz Stability Criterion, Relative stability analysis,

The Root Locus Technique: Introduction, The Root Locus concepts, Construction of Root Loci

**UNIT IV Frequency Response Analysis**

Frequency response analysis: Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion

**UNIT V State Variable Analysis and Design**

State Variable Analysis and Design: Introduction, Concepts of State, State Variables and State models, State models for linear continuous-time systems, State variables and linear discrete-time systems, Solution of state equations and Concepts of Controllability and Observability.

**Textbooks:**

1. I. J. Nagarath and M. Gopal, “Control System Engineering,” New Age International Publishers, Fifth Edition.

**References:**

1. Katsuhiko Ogata, Modern Control Engineering, Pearson, 5th Edition, 2010.
2. S. Salivahanan, R. Rengaraj, and G. R. Venkata Krishnan, Control Systems Engineering, Pearson, 5th edition, 2015.
3. Benjamin C. Kuo, FraridGolnaraghi, Automatic Control Systems, Wiley Student Edition, Eighth Edition2015.

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**B.Tech (ECE)– III-I Sem L T P C**

**3 0 0 3**

**(20A04502T) DIGITAL SIGNAL PROCESSING**

**Course Objectives:**

* To describe discrete time signals and systems.
* To teach importance of FFT algorithm for computation of Discrete Fourier Transform.
* To expose various implementations of digital filter structures.
* To present FIR and IIR Filter design procedures.
* To outline need of Multi-rate Processing.

**Course Outcomes:**

* Formulate difference equations for the given discrete time systems
* Apply FFT algorithms for determining the DFT of a given signal
* Compare FIR and IIR filter structures
* Design digital filter (FIR & IIR) from the given specifications
* Outline the concept of multirate DSP and applications of DSP.

**UNIT I**

Introduction to discrete time signals and systems

Introduction to digital signal processing, review of discrete-time signals and systems, analysis of discrete-time linear time invariant systems, frequency domain representation of discrete time signals and systems, analysis of linear time-invariant systems in the z-domain, pole-zero stability.

**UNIT II**

Discrete Fourier Transform - Introduction, Discrete Fourier Series, properties of DFS, Discrete Fourier Transform, Inverse DFT, properties of DFT, Linear and Circular convolution, convolution using DFT.

Fast Fourier Transform = Introduction, Fast Fourier Transform, Radix-2 Decimation in time and Decimation in frequency FFT, Inverse FFT (Radix-2).

**UNIT III**

IIR Filters-Introduction to digital filters, Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters by Impulse invariant and bilinear transformation methods, Frequency transformations, Basic structures of IIR Filters - Direct form-I, Direct form-II, Cascade form and Parallel form realizations.

**UNIT IV**

FIR Filters-Introduction, Characteristics of FIR filters with linear phase, Frequency response of linear phase FIR filters, Design of FIR filters using Fourier series and windowing methods (Rectangular, Triangular, Raised Cosine, Hanging, Hamming, Blackman), Comparison of IIR & FIR filters, Basic structures of FIR Filters – Direct form, Cascade form, Linear phase realizations.

**UNIT V**

Quantization Errors in Digital Signal Processing: Representation of numbers, Quantization of filter coefficients, Round-off Effects in digital filters.

Multirate Digital Signal Processing: Decimation, Interpolation, Sampling rate conversion by a rational factor; Frequency domain characterization of Interpolator and Decimator; Polyphase decomposition.

**Textbooks:**

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education, 2007.
2. A.V.Oppenheim and R.W. Schaffer, Discrete Time Signal Processing ,PHI.

**References:**

1. S.K.Mitra, Digital Signal Processing – A practical approach , 2nd Edition, Pearson Education, New Delhi, 2004.
2. MH Hayes, Digital Signal Processing, Schaum’s Outline series, TATA Mc-Graw Hill, 2007.
3. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using Matlab, Thomson, 2007.

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**3 0 0 3**

**(20A04503T) MICROPROCESSORS AND MICROCONTROLLERS**

**Course Objectives:**

* To introduce fundamental architectural concepts of microprocessors and microcontrollers.
* To impart knowledge on addressing modes and instruction set of 8086 and 8051
* To introduce assembly language programming concepts
* To explain memory and I/O interfacing with 8086 and 8051
* To introduce16 bit and 32 bit microcontrollers.

**Course Outcomes:**

* Distinguish between microprocessors & microcontrollers
* Develop assembly language programming
* Describe interfacing of 8086 with peripheral devices
* Design applications using microcontrollers

**UNIT I**

**8086 Architecture**: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.

**UNIT II**

**8086 Programming**: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

**UNIT III**

**8086 Interfacing**: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

**UNIT IV**

Microcontroller - Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V**

Interfacing Microcontroller - Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

**Textbooks**:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rdEdition,1994.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

**References:**

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.

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**B.Tech (ECE)– III-I Sem L T P C**

**3 0 0 3**

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|  | **(20A05602T) MACHINE LEARNING** |  |  |  |  |
| **Course Objectives:** | | | | | |
| The course is introduced for students to   * Gain knowledge about basic concepts of Machine Learning * Study different learning algorithms * Learn about of evaluation of learning algorithms * Learn about Dimensionality reduction | | | | | |
| **Course Outcomes:** | | | | | |
| After completion of the course, students will be able to   * Identify machine learning techniques suitable for a given problem * Solve the problems using various machine learning techniques * Apply Dimensionality reduction techniques * Design application using machine learning techniques | | | | | |
| **UNIT I** |  | Lecture 8Hrs | | | |
| Introduction: Definition of learning systems, Goals and applications of machine learning, Aspects of developing a learning system: training data, concept representation, function approximation.  Inductive Classification: The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Learning conjunctive concepts, The importance of inductive bias. | | | | | |
| **UNIT II** |  | Lecture 8Hrs | | | |
| Decision Tree Learning: Representing concepts as decision trees, Recursive induction of decision trees,  Picking the best splitting attribute: entropy and information gain, searching for simple trees and computational complexity, Occam's razor, Overfitting, noisy data, and pruning.  Experimental Evaluation of Learning Algorithms: Measuring the accuracy of learned hypotheses.  Comparing learning algorithms: cross-validation, learning curves, and statistical hypothesis testing. | | | | | |
| **UNIT III** |  | Lecture 9Hrs | | | |
| Computational Learning Theory: Models of learnability: learning in the limit; probably approximately correct (PAC) learning. Sample complexity for infinite hypothesis spaces, Vapnik- Chervonenkis dimension.  Rule Learning: Propositional and First-Order, Translating decision trees into rules, Heuristic rule induction using separate and conquer and information gain, First-order Horn-clause induction (Inductive Logic Programming) and Foil, Learning recursive rules, Inverse resolution, Golem, and Progol. | | | | | |
| **UNIT IV** |  | Lecture 9Hrs | | | |
| Artificial Neural Networks: Neurons and biological motivation, Linear threshold units. Perceptrons: representational limitation and gradient descent training, Multilayer networks and back propagation, Hidden layers and constructing intermediate, distributed representations. Over fitting, learning network structure, recurrent networks.  Support Vector Machines: Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. | | | | | |
| **UNIT V** |  | Lecture 9Hrs | | | |
| Bayesian Learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies.  Instance-Based Learning: Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning. | | | | | |
| **Textbooks:** | | | | | |
| 1. T.M. Mitchell, “Machine Learning”, McGraw-Hill,1997. 2. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019. | | | | | |
| **Reference Books:** | | | | | |
| 1. EthernAlpaydin, “Introduction to Machine Learning”, MIT Press,2004. 2. Stephen Marsland, “Machine Learning -An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014. 3. Andreas C. Müller and Sarah Guido “Introduction to Machine Learning with Python:A Guide for Data Scientists”,Oreilly. | | | | | |
| **Online Learning Resources:** | | | | | |
| 1. Andrew Ng, “Machine Learning”<https://www.deeplearning.ai/machine-learning-> [yearning/](https://www.deeplearning.ai/machine-learning-yearning/) 2. Shai Shalev-Shwartz , Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms” , Cambridge University Press. <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html> 3. <http://nptel.ac.in/courses/106106139/> | | | | | |

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**3 0 0 3**

**(20A04504a) COMPUTER ARCHITECTURE & ORGANIZATION**

**Course Objectives:**

The purpose of the course is to introduce principles of computer organization and the basic architectural concepts.

**Course Outcomes:**

* Understand the basics of instructions sets and their impact on processor design.
* Demonstrate an understanding of the design of the functional units of a digital computer

system.

* Evaluate cost performance and design trade-offs in designing and constructing a computer

processor including memory.

* Design a pipeline for consistent execution of instructions with minimum hazards.
* Recognize and manipulate representations of numbers stored in digital computers.

**UNIT I**

Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

Register Transfer Language and Micro operations: Register Transfer language, Register Transfer, Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.

Basic Computer Organization and Design: Instruction codes, Computer Registers Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt.

**UNIT II**

Micro programmed Control: Control memory, Address sequencing, micro program example, design of control unit.

Central Processing Unit: General Register Organization, Instruction Formats, Addressing modes, Data Transfer and Manipulation, Program Control.

**UNIT III**

Data Representation: Data types, Complements, Fixed Point Representation, Floating Point Representation.

Computer Arithmetic: Addition and subtraction, multiplication Algorithms, Division Algorithms, Floating – point Arithmetic operations. Decimal Arithmetic unit, Decimal Arithmetic operations.

**UNIT IV**

Input-Output Organization: Input-Output Interface, Asynchronous data transfer, Modes of Transfer,

Priority Interrupt Direct memory Access.

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory,

Cache Memory.

**UNIT V**

Reduced Instruction Set Computer: CISC Characteristics, RISC Characteristics. Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processor. Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor arbitration, Interprocessor communication and synchronization, Cache Coherence.

**Textbook:**

1. Computer System Architecture – M. Moris Mano, Third Edition, Pearson/PHI.

**References:**

1. Computer Organization – Car Hamacher, ZvonksVranesic, SafeaZaky, V th Edition, McGraw Hill.
2. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
3. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.

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**B.Tech (ECE)– III-I Sem L T P C**

**3 0 0 3**

**(20A04504b) INFORMATION THEORY AND CODING**

**Course Objectives:**

* To teach basic parameters of Information, concepts of source coding techniques and error control coding techniques.
* To transmit knowledge on Information theory and error control coding technique for solving problems.
* To Introduce various source coding and channel coding techniques for error detection and error correction in the information bearing signals.
* To dissimilate block to variable length coding and variable to block length codingtechniques for merits and demerits.
* To describe various systems for linear block codes and convolutional codes.

**Course Outcomes**:

* Describe basic parameters of Information, the concepts of source coding techniques, and Error Control coding techniques
* Apply knowledge of Information theory and error control coding techniques to solve problems
* Analyze various source coding and channel coding techniques for error detection and error correction in the information bearing signals
* Compare various block to variable length coding and variable to block length coding techniques for merits and demerits
* Design various systems for linear block codes and convolutional codes

**UNIT I**

Information Theory: Introduction, Definition of Entropy, Conditional Entropy, Relative Entropy, Basic Properties of Entropy, Mutual Information, Information Inequalities, Problem solving.

Block to Variable length Coding: Prefix-free Code, Coding a single Random Variable, Prefix, Free Code, Kraft Inequality, Bounds on optimal Code length, Coding a Single Random Variable, Rooted Tree with Probabilities, Shanon-Fano Coding, Free fix code, Coding an information Source, Huffman Coding, Example.

Variable to Block Length Coding: Proper message set, Assigning probabilities to K-ary rooted tree corresponding to a proper message set, Prefix free Coding of a proper message set, Tunstall message set, Tunstall coding.

**UNIT II**

Asymptotic Equi-partition Property, Chebyshev inequality, Weak law of large numbers, Typical Sequences, Block to Block Coding of DMS: Consequences of Asymptotic Equipartition Property, Problem solving.

Universal Source Coding: Lempel-Ziv Algorithm, LZ -77 Encoding and Decoding, Lempel- Ziv Welch (LZW) Algorithm, LZW Encoding, and Decoding.

Coding of Sources with memory, Channel Capacity, Noisy Channel Coding Theorem, Differential Entropy, Gaussian Channel, Rate Distortion Theory, Blahut-Arimoto Algorithm, problem solving.

**UNIT III**

Error Control Coding: Introduction to Error Control Codes, Error Probability with Repetition in the Binary Symmetric Channel, Parity Check Bit Coding for Error Detection, Block Coding for Error Detection and Correction, The Hamming Distance, The upper bound of the Probability of Error with Coding, Soft Decision Decoding, Hard Decision Decoding.

**UNIT IV**

Linear Block Codes, Introduction to Linear Block Codes, Syndrome and Error Detection, Encoding Block Codes, Decoding of Block Codes, Single Parity Check bit Code, Repeated Codes, Hadamard Code, Hamming Code, Cyclic Codes, Generator and Parity-Check Matrices of Cyclic Codes, Encoding and Decoding of Cyclic Codes, BCH codes, Reed-Solomon Code.

**UNIT V**

Convolutional Coding, Code Generation, Decoding Convolutional Code, the Code Tree, Decoding in the presence of Noise, State and Trellis Diagrams, The Viterbi Algorithm, Comparison of Error Rates in Coded and Uncoded Transmission, Turbo Codes, LDPC codes, Hard and Soft Decision Decoding.

**Textbooks:**

1. Thomas M.Cover, Joy A. Thomas, Elements of Information Theory, John Wiley & Sons,2nd Edition, 2006.
2. Herbert Taub, Donald L Shilling, Goutam Saha, Principles of Communication Systems, 4th Edition, McGraw Hill, 2017.

**References:**

1. Shu Lin, Daniel J. Costello Jr., Error Control Coding, Pearson, Second Edition, 2013.
2. Simon Haykin, Communication Systems, John Wiley, 4th Edition, 2010.

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**0 0 3 1.5**

**(20A04502P) DIGITAL SIGNAL PROCESSING LAB**

**Course Outcomes:**

* Implement various DSP Algorithms using software packages.
* Implement DSP algorithms with Digital Signal Processor.
* Analyze and observe magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters.
* Analyze and observe magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters using window techniques.
* Analyze digital filters using Software Tools.

The Programs shall be implemented in Software (Using MATLAB / Lab View / C Programming/ Equivalent) and Hardware (Using TI / Analog Devices / Motorola / Equivalent DSP processors).

**List of Experiments:**

1. Generate the following standard discrete time signals.
2. Unit Impulse ii) Unit step iii) Ramp iv) Exponential v) Sawtooth
3. Generate sum of two sinusoidal signals and find the frequency response (magnitude and phase).
4. Implement and verify linear and circular convolution between two given signals.
5. Implement and verify autocorrelation for the given sequence and cross correlation between two given signals.
6. Compute and implement the N-point DFT of a given sequence and compute the power density spectrum of the sequence.
7. Implement and verify N-point DIT-FFT of a given sequence and find the frequency response (magnitude and phase).
8. Implement and verify N-point IFFT of a given sequence.
9. Design IIR Butterworth filter and compare their performances with different orders (Low Pass Filter /High Pass Filter)
10. Design IIR Chebyshev filter and compare their performances with different orders (Low Pass Filter /High Pass Filter).
11. Design FIR filter (Low Pass Filter /High Pass Filter) using windowing technique.
12. Using rectangular window
13. Using hamming window
14. Using Kaiser window
15. Design and verify Filter (IIR and FIR) frequency response by using Filter design and Analysis Tool.
16. Compute the Decimation and Interpolation for the given signal.
17. Real time implementation of an audio signal using a digital signal processor.
18. Compute the correlation coefficient for the two given audio signals of same length using a digital signal processor.

**Note: Any TWELVE of the experiments are to be conducted.**

|  |
| --- |
| **References:** |
| 1. Digital Signal Processing: Alon V. Oppenhelm, PHI  2. Digital Signal processing (II-Edition): S.K. Mitra, TMH |
| **Online Learning Resources/Virtual Labs:** |
| **1.** [**http://vlabs.iitkgp.ac.in/dsp/#**](http://vlabs.iitkgp.ac.in/dsp/) |

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**(20A04503P) MICROPROCESSORS AND MICROCONTROLLERS LAB**

**Course Objectives:**

To acquire the knowledge on microprocessors and microcontrollers, interfacing various peripherals, configure and develop programs to interface peripherals/sensors.

**Course Outcomes:**

* Formulate problems and implement algorithms using Assembly language.
* Develop programs for different applications.
* Interface peripheral devices with 8086 and 8051.
* Use Assembly/Embedded C programming approach for solving real world problems

**List of Experiments:**

1. PROGRAMS FOR 16 BIT ARITHMETIC OPERATIONS (Using various addressing modes)
2. Write an ALP to Perform Addition and Subtraction of Multi precision numbers.
3. Write an ALP to Perform Multiplication and division of signed and unsigned Hexadecimal numbers.
4. Write an ALP to find square, cube and factorial of a given number.
5. PROGRAMS INVOLVING BIT MANIPULATION INSTRUCTIONS
6. Write an ALP to find the given data is positive or negative.
7. Write an ALP to find the given data is odd or even.
8. Write an ALP to find Logical ones and zeros in a given data.
9. PROGRAMS ON ARRAYS FOR 8086
10. Write an ALP to find Addition/subtraction of N no‘s.
11. Write an ALP for finding largest/smallest no.
12. Write an ALP to sort given array in Ascending/descending order.
13. PROGRAM FOR STRING MANIPULATIONS FOR 8086
14. Write an ALP to find String length.
15. Write an ALP for Displaying the given String.
16. Write an ALP for Comparing two Strings.
17. Write an ALP to reverse String and Checking for palindrome.
18. PROGRAM FOR DIGITAL CLOCK DESIGN USING 8086
19. Write an ALP for Designing clock using INT 21H Interrupt.
20. Write an ALP for Designing clock using DOS Interrupt Functions.
21. Write an ALP for Designing clock by reading system time.
22. INTERFACING STEPPER MOTOR WITH 8086
23. Write an ALP to 8086 processor to Interface a stepper motor and operate it in clockwise by choosingvariable step-size.
24. Write an ALP to 8086 processor to Interface a stepper motor and operate it in Anti-clockwise bychoosing variable step-size.
25. INTERFACING ADC/DAC WITH 8086
26. Write an ALP to 8086 processor to Interface ADC.
27. Write an ALP to 8086 processor to Interface DAC and generate Square Wave/Triangular Wave/Stepsignal.
28. COMMUNICATION BETWEEN TWO MICROPROCESSORS
29. Write an ALP to have Parallel communication between two microprocessors using 8255
30. Write an ALP to have Serial communication between two microprocessor kits using 8251.
31. PROGRAMS USING ARITHMETIC AND LOGICAL INSTRUCTIONS FOR 8051
32. Write an ALP to 8051 Microcontroller to perform Arithmetic operations like addition, subtraction,
33. Multiplication and Division.
34. Write an ALP to 8051 Microcontroller to perform Logical operations like AND, OR and XOR.
35. Programs related to Register Banks.
36. PROGRAM TO VERIFY TIMERS/COUNTERS OF 8051
37. Write a program to create a delay of 25msec using Timer0 in mode 1 and blink all the Pins of P0.
38. Write a program to create a delay of 50 µsec using Timer1 in mode 0 and blink all the Pins of P2.
39. Write a program to create a delay of 75msec using counter0 in mode 2 and blink all the Pins of P1.
40. Write a program to create a delay of 80 µsec using counter1 in mode 1 and blink all the Pins of P3.
41. UART OPERATION IN 8051
42. Write a program to transfer a character serially with a baud rate of 9600 using UART.
43. Write a program to transfer a character serially with a baud rate of 4800 using UART.
44. Write a program to transfer a character serially with a baud rate of 2400 using UART.
45. INTERFACING LCD WITH 8051
46. Develop and execute the program to interface16\*2 LCD to 8051.
47. Develop and execute the program to interface LCD to 8051 in 4-bit or 8-bit mode.

**Reference Books:**

1. Kenneth.J.Ayala. The 8051 microcontroller, 3rd edition, Cengage learning,2010.
2. Advanced microprocessors and peripherals-A.K ray and K.M.Bhurchandani, TMH, 2nd edition2006.
3. The 8051 Microcontroller and Embedded Systems: Using Assembly and C by Muhammad AliMazidi, Janice GillispieMazidi, Second Edition.

**Note: Any TEN of the experiments are to be conducted.**

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**1 0 2 2**

(20A04506) PCB DESIGN AND PROTOTYPE DEVELOPMENT

**(Skill Oriented Course – III)**

**Course Objectives:**

This course will teach teams of students how to design and fabricate PCB for prototyping as well as in Industrial Production environment. This will help students to innovate faster with electronics technology.

**Course Outcomes:**

* Understand a single layer and multilayer PCB
* Create and fabricate a PCB
* Evaluate and test a PCB

**UNIT I**

Fundamental of basic electronics: Component identification, Component symbols & their footprints, understand schematic, Creating new PCB, Browsing footprints libraries, Setting up the PCB layers, Design rule checking, Track width selection, Component selection, Routing and completion of the design

**UNIT II**

Introduction to PCB: Definition and Need/Relevance of PCB, Background and History of PCB, Types of PCB, Classes of PCB Design, Terminology in PCB Design, Different Electronic designautomation (EDA)tools and comparison.

**UNIT III**

PCB Design Process: PCB Design Flow, Placement and routing, Steps involved in layout design, Artwork generation Methods - manual and CAD, General design factors for digital and analogue circuits, Layout and Artwork making for Single-side, double-side and Multilayer Boards, Design for manufacturability, Design-specification standards

**Practice Exercises: Any twelve experiments are to be done**

1. Practice following PCB Design steps

* Schematic Design: Familiarization of the Schematic Editor, Schematic creation, Annotation, Netlist generation.
* Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic.
* Create new schematic components.
* Create new component footprints.

1. Regulator circuit using 7805
2. Inverting Amplifier or Summing Amplifier using op-amp
3. Full-wave Rectifier
4. Astable multivibrator using IC555
5. Monostable multivibrator using IC555
6. RC Phase-shift or Wein-bridge Oscillator using transistor.
7. Full-Adder using half-adders.
8. 4-bit binary /MOD N counter using D-Flip flops.
9. One open-ended (analog/ digital/mixed circuit) experiments of similar nature and magnitude to the above are to be assigned by the teacher

(Student is expected to solve and execute/simulate independently).

# Design an 8051 Development board havingPowersectionconsistingofIC7805, capacitor, resistor, headers, LED.

1. Design an 8051 Development board having Serial communication section consisting of MAX 232, Capacitors, DB9connector, Jumper, LEDs
2. Design an 8051 Development board having Reset & Input/output sections consisting of 89C51Microcontroller, Electrolytic Capacitor, Resistor, Jumper, Crystal Oscillator, Capacitors
3. Fabricate a single-sided PCB, mount the components and assemble them in a cabinet for any one of the circuits mentioned in the above exercises.

**References:**

1. Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002
2. R. Tummala, Fundamentals of Microsystems Packaging, McGraw-Hill 2001
3. C. Robertson. PCB Designer´s Reference. Prentice Hall, 2003
4. Open-source EDA Tool KiCad Tutorial: http://kicad-pcb.org/help/tutorials/ 13. PCB Fabrication user guide page:

http://www.wikihow.com/Create-Printed-Circuit-Boards

<http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication/>

<http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself>

PCB Fabrication at home(video): https://www.youtube.com/watch?v=mv7Y0A9YeUc, https://www.youtube.com/watch?v=imQTCW1yWkg

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**(20A04601T) ANTENNAS &MICROWAVE ENGINEERING**

**Course Objectives:**

* To enable the student to understand the basic principles in antenna and microwave system design
* To make the student to acquire knowledge in the area of various antenna designs.
* To enhance the student knowledge in the area of microwave components and antenna for practical applications.

**Course Outcomes: At the end of this course, the students will be able to**

* Learn about the antenna’s basics and wire antennas.
* Gain knowledge on few types of antennas, their operation and applications.
* Understand the uses of antenna arrays and analyze waveguides and resonators
* Analyze various microwave components and understand the principles of different microwave sources.
* Gain knowledge on microwave semiconductor devices and microwave measurements.

**UNIT I**

Antenna Basics &Wire Antennas: Definition of antenna, Radiation Mechanism – single wire, two wire, dipoles, Antenna Parameters - Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Aperture Efficiency, Effective Height and length, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Field Components, Radiated power, Radiation Resistance, Loop Antennas - Introduction, Small Loop, Comparison of far fields of small loop and short dipole, Radiation Resistances and Directives of small and large loops (Qualitative Treatment), Arrays with Parasitic Elements - Yagi - Uda Arrays, Folded Dipoles & their characteristics

**UNIT II**

VHF, UHF and Microwave Antennas: Helical Antennas-Helical Geometry, Helix modes, Horn Antennas- Types, Fermat’s Principle, Optimum Horns, Design considerations of Pyramidal Horns, Micro strip Antennas- Introduction, features, advantages and limitations, Rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas, reflector antennas - Introduction, corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Reflector Types - Related Features, Lens Antennas - Geometry of Non-metallic Dielectric Lenses, Zoning , Tolerances, Applications

**UNIT III**

Antenna Arrays and propagation: Arrays of 2 Isotropic sources- Different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, Bionomial Arrays, Different modes of wave propagation, Ground wave propagation Space wave propagation - Sky wave propagation **(Qualitative treatment).**

Waveguides: Introduction, Rectangular waveguides, Field expressions for TE and TM modes, Wave propagation in the guide, Phase and group velocities, Power transmission and attenuation, Waveguide current and mode excitation, Circular waveguide – TE and TM modes, Wave propagation, waveguide resonators.

**UNIT IV**

**Passive Microwave Devices:** Introduction to scattering parameters and their properties, Terminations, Variable short circuit, Attenuators, Phase shifters, Hybrid Tees (H-plane, E-plane, Magic Tees), Hybrid ring, Directional Couplers – Bethe hole and Two hole Couplers, Microwave propagation in Ferrites, Microwave devices employing Faraday rotation – Isolator, Circulator, Deriving Scattering matrix for Microwave passive devices.

**Microwave Amplifiers and Oscillators:** Microwave Tubes: Linear Beam Tubes – Two cavity Klystron amplifier -velocity modulation, bunching process, output power, Reflex Klystron oscillator, power output and efficiency, Travelling Wave Tube (TWT) – Bunching process and amplification process (**Qualitative treatment only**). Crossed Field Tubes – Magnetron oscillator, pi-mode operation, power output and efficiency, Hartree Condition.

**UNIT V**

**Microwave Semiconductor Devices:** Gunn Oscillator – Principle of operation, Characteristics, Two valley model, IMPATT, TRAPATT diodes.

**Antennas and Microwave Measurements: S**ources of errors, Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods). Description of Microwave bench-different blocks and their features, errors and precautions, Microwave power measurements, Measurement of attenuation, frequency, VSWR (low, medium, high), Measurement of ‘Q’ of a cavity, Impedance measurements.

**Textbooks:**

1. John D. Kraus, Ronald J. Marhefka and Ahmad S.Khan, “Antennas and Wave propagation”, TMH, New Delhi, 4th Ed., 2010.
2. Samuel Y. Liao, “Microwave devices and circuits”, 3rd Edition, Pearson Publishing, 2003.

**References:**

1. R. E. Collin, “Foundations for microwave engineering”, 2nd Edition, John Wiley, 2002.
2. C.A. Balanis, “Antenna Theory- Analysis and Design”, John Wiley & Sons, 2nd Edn., 2001.
3. M. Kulkarni, “Microwave and Radar Engineering”, Umesh Publications, 4th edition 2009.
4. G.S.N Raju, “Antenna and Wave Propagation”, Pearson Education India, 3rd Edition 2009.

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**(20A04602T) VLSI DESIGN**

**Course Objectives:**

* To give exposure to different steps involved in fabrication of ICs using MOS transistor, CMOS/BICOM transistors and passive components.
* To provide knowledge on electrical properties of MOS &BICMOS devices to analyze the behavior of inverters designed with various loads.
* To provide concepts to design building blocks of data path of any system using gates.
* To teach about basic programmable logic devices and testing of CMOS circuits.

**Course Outcomes:**

* Acquire qualitative knowledge about the fabrication process of integrated circuit using MOS transistors,
* Draw the layout of any logic circuit which helps to understand and estimate parasitic of any logic circuit
* Design building blocks of data path using gates.
* Design simple memories using MOS transistors and can understand design of large memories
* Understand the concept of testing and adding extra hardware to improve testability of system

**UNIT I**

Introduction: Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS &BiCMOS Technologies Basic Electrical Properties of MOS and BiCMOS Circuits: IDS - VDS relationships, MOS transistor Threshold Voltage-VT, figure of merit-ω0, Transconductance - gm, gds ; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

**UNIT II**

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

**UNIT III**

Gate level Design: Logic gates and other complex gates, Switch logic, Alternate gate circuits. Basic Circuit Concepts: Sheet Resistance Rs and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out

**UNIT IV**

Subsystem Design: Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

**UNIT V**

CMOS Testing: Need for testing, Design for testability - built in self-test (BIST) – testing combinational logic –testing sequential logic – practical design for test guide lines – scan design techniques.

**Textbooks:**

1. Essentials of VLSI Circuits and Systems, Kamran Eshraghian, EshraghianDougles, A. Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3 Ed., 1997, Pearson Education.

**References:**

1. CMOS VLSI Design-A Circuits and Systems Perspective, Neil H.E Weste, David Harris, Ayan Banerjee, 3rd Edn, Pearson, 2009.
2. BehzadRazavi , “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2003.
3. Jan M. Rabaey, “Digital Integrated Circuits”, AnanthaChandrakasan and Borivoje Nikolic, Prentice-Hall of India Pvt.Ltd, 2nd edition, 2009.

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**(20A04603T) DATA COMMUNICATION &NETWORKS**

**Course Objectives:**

To provide a solid conceptual understanding of the fundamentals of data communications and computer networks.

**Course Outcomes:**

* Understand the basics of data communication, networking, internet and their importance.
* Analyze the services and features of various protocol layers in data networks.
* Differentiate wired and wireless computer networks
* Analyse TCP/IP and their protocols.
* Recognize the different internet devices and their functions.

**UNIT I**

Data Communications: Components, protocols and standards, Network and Protocol Architecture, Reference Model ISO-OSI, TCP/IP-Overview, topology, transmission mode, digital signals, digital to digital encoding, digital data transmission, DTE-DCE interface, interface standards, modems, cable modem, transmission media guided and unguided, transmission impairment, Performance, wavelength and Shannon capacity. Review of Error Detection and Correction codes. Switching: Circuit switching (space-division, time division and space-time division), packet switching (virtual circuit and Datagram approach), message switching.

**UNITII**

Data Link Layer: Design issues, Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ. Sliding window protocol, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, Point-to –Point Access: PPPPoint –to- Point Protocol, PPP Stack

**UNIT III**

Medium Access Sub layer: Channel allocation problem, Controlled Access, Channelization, multiple access protocols, IEEE standard 802.3 & 802.11 for LANS and WLAN, high-speed LANs, Token ring, Token Bus,FDDI based LAN, Network Devices-repeaters, hubs, switches bridges.

**UNITIV**

Network Layer: Design issues, Routing algorithms, Congestion control algorithms, Host to Host Delivery: Internetworking, addressing and routing, IP addressing (class full & Classless), Subnet, Network Layer Protocols: ARP, IPV4, ICMP, IPV6 ad ICMPV6.

**UNIT V**

Transport Layer: Process to Process Delivery: UDP; TCP, congestion control and Quality of service.

Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail(SMTP), file transfer (FTP), HTTP and WWW.

**Textbooks:**

1. S. Tannenbum, D. Wetherall, ―Computer Networks‖, Prentice Hall, Pearson, 5thEd
2. Behrouz A. Forouzan, ―Data Communications and Networking‖, Tata McGraw-Hill, 4th Ed

**References:**

1. Fred Halsall, ―Computer Networks‖, Addison – Wesley Pub. Co. 1996.
2. Larry L, Peterson and Bruce S. Davie, ―Computer Networks: A system Approach‖, Elsevier, 4thEd
3. Tomasi, ―Introduction To Data Communications & Networking‖, Pearson 7th impression 2011
4. William Stallings, ―Data and Computer Communications‖, Prentice Hall, Imprint of Pearson, 9thEd.

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**(20A04604a) ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**

**(Professional Elective Course- II)**

**Course Objectives:**

The objective of the course is to introduce the fundamentals of Electronics Instruments and Measurement providing an in-depth understanding of Measurement errors, Bridge measurements, Digital Storage Oscilloscope, Function Generator and Analyzer, Display devices, Data acquisition systems and transducers.

**Course Outcomes:**

* Explain operation of various instruments required in measurements
* Apply measurement techniques for different types of tests
* Select specific instruments for specific measurement function
* Use oscilloscope to determine frequency and phase of a sinusoidal signal
* Compare different types of bridge circuits
* Analyze various measuring techniques for both electrical and nonelectrical quantities

**UNIT 1**

Performance characteristics of Instruments: Static characteristics, Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, and their statistical analysis, dynamic characteristics-speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters, AC voltmeters Thermocouple type RF ammeter, ohm meters, series type, shunt type, multi meter for voltage, current and resistance measurements.

**UNIT II**

Oscilloscopes: Standard specifications of CRO,CRT features, vertical and horizontal amplifiers, horizontal and vertical deflection systems, sweep trigger pulse, delay line, sync selector circuits, probes for CRO – active, passive, and attenuator type, dual trace/beam CRO, Principles of sampling oscilloscope, storage oscilloscope, and digital storage oscilloscope, Digital frequency counters, time & Period measurements.

**UNIT III**

Signal Generators and Analyzers: Fixed and variable frequency AF oscillators, function generators, pulse, random noise, sweep, and arbitrary waveform generators, their standards, specifications and principles of working (Block diagram approach); Wave analyzers, Harmonic distortion analyzers, Spectrum analyzers, and Logic analyzers.

**UNIT IV**

Bridges: Wheatstone bridge, We in Bridge, errors and precautions in using bridges, AC bridges: Measurement of inductance-Maxwell’s bridge, Anderson Bridge. Measurement of capacitance- Schearing Bridge, Kelvin Bridge, Q-meter, EMI and EMC, Interference and noise reduction techniques.

**UNIT V**

Sensors and Transducers: Active and passive transducers: Measurement of displacement (Resistance, capacitance, inductance; LVDT) Force (strain gauges) Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples, and thermistors), Velocity, Acceleration, Vibration, pH measurement.

**Textbooks**:

1. H.S.Kalsi, Electronic Instrumentation, 3rdedition, McGraw Hill Education, 2017.

**References**:

1. D. Helfrick, W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, ,1st edition, Pearson Education India, 2015
2. David A. Bell, Electronic Instrumentation and Measurements, Oxford Univ. Press, 2007
3. B.M. Oliver, J.M. Cage, Electronic Measurements and Instrumentation, TMH Reprint 2009.
4. Ernest O. Doebelin and Dhanesh N Manik, Measurement Systems, 6th Ed., TMH,2010.

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**(20A04604b) EMBEDDED SYSTEM DESIGN**

**(Professional Elective Course- II)**

**Course Objectives:**

* To teach the basics of an embedded system and RTOS.
* To introduce the typical components of an embedded system & different communication interfaces.
* To provide knowledge on the design process of embedded system applications

**Course Outcomes:**

* Identify hardware and software components of an embedded system
* Learn the basics of OS and RTOS
* Illustrate different Inter Process Communication (IPC) mechanisms used by tasks/process/tasks to communicate in multitasking environment
* Design simple embedded system-based applications

**UNITI I NTRODUCTION TO EMBEDDED SYSTEMS**

History of embedded systems, Classification of embedded systems based on generation and complexity, Purpose of embedded systems, The embedded system design process-requirements, specification, architecture design, designing hardware and software, components, system integration, Applications of embedded systems, and characteristics of embedded systems.

**UNIT II TYPICAL EMBEDDED SYSTEM**

Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems, Sensors, actuators, I/O components: seven segment LED, relay, piezo buzzer, push button switch, other sub-systems: reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

**UNIT III COMMUNICATION INTERFACE**

Onboard communication interfaces-I2C, SPI, CAN, parallel interface; External communication interfaces-RS232 and RS485, USB, infrared, Bluetooth, Wi-Fi, ZigBee, GPRS, GSM.

**UNIT IV EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT**

Embedded firmware design approaches-super loop based approach, operating system based approach; embedded firmware development languages-assembly language based development, high level language based development.

**UNIT V RTOS BASED EMBEDDED SYSTEM DESIGN**

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-pre-emptive and pre-emptive scheduling; task communication-shared memory, message passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/ Synchronization Issues, Task Synchronization Techniques

**Textbooks:**

1. Introduction to Embedded Systems - Shibu KV, Mc Graw Hill Education.
2. Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

**References:**

1. Embedded System Design -frank vahid, tony grivargis, john Wiley.
2. Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.
3. Embedded Systems – Raj Kamal, TMH

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**(20A04604c) OPTICAL COMMUNICATIONS**

**(Professional Elective Course- II)**

**Course Objectives:**

* To understand the construction and characteristics of optical fibre cable.
* To develop the knowledge of optical signal sources and power launching.
* To identify and understand the operation of various optical detectors.
* To understand the design of optical systems and WDM.

**Course Outcomes:**

At the end of the course, the student will be able to:

* Understand and analyze the constructional parameters of optical fibres.
* Estimate the losses due to attenuation, absorption, scattering and bending.
* Compare various optical detectors and choose suitable one for different applications.

**UNIT I**

Overview of Optical Fiber Communication: - Historical development, The general system, Advantages of Optical Fiber Communications, Optical Fiber Wave Guides- Introduction, Ray Theory Transmission, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Cylindrical Fibers- Modes, V number, Mode Coupling, Step Index Fibers, Graded Index Fibers. Single Mode Fibers- Cut Off Wavelength, Mode Field Diameter, Effective Refractive Index, Fiber Materials Glass, Halide, Active Glass, Chalgenide Glass, Plastic Optical Fibers.

**UNIT II**

Signal Distortion in Optical Fibers: Attenuation, Absorption, Scattering and Bending Losses, Core and Cladding Losses, Information Capacity Determination, Group Delay, Types of Dispersion - Material Dispersion, Wave-Guide Dispersion, Polarization Mode Dispersion, Intermodal Dispersion, Pulse Broadening, Optical Fiber Connectors- Connector Types, Single Mode Fiber Connectors, Connector Return Loss.

**UNIT III**

Fiber Splicing: Splicing Techniques, Splicing Single Mode Fibers, Fiber Alignment and Joint Loss- Multimode Fiber Joints, Single Mode Fiber Joints. Optical Sources- LEDs, Structures, Materials, Quantum Efficiency, Power, Modulation, Power Bandwidth Product, Injection Laser Diodes- Modes, Threshold Conditions, External Quantum Efficiency, Laser Diode Rate Equations, Resonant Frequencies, Reliability of LED & ILD.

**UNIT IV**

Optical Detectors: Physical Principles of PIN and APD, Detector Response Time, Temperature Effect on Avalanche Gain, Comparison of Photo Detectors, Optical Receiver Operation- Fundamental Receiver Operation, Digital Signal Transmission, Error Sources, Receiver Configuration, Digital Receiver Performance, Probability of Error, Quantum Limit, Analog Receivers.

**UNIT V**

Optical System Design: Considerations, Component Choice, Multiplexing, Point-to- Point Links, System Considerations, Link Power Budget with Examples, Overall Fiber Dispersion in Multi-Mode and Single Mode Fibers, Rise Time Budget with Examples. Transmission Distance, Line Coding in Optical Links, WDM, Necessity, Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye Pattern.

**Textbooks:**

1. Optical Fiber Communications – Gerd Keiser, MC GRAW HILL EDUCATION, 4th Edition, 2008.

2. Optical Fiber Communications – John M. Senior, Pearson Education, 3rd Edition, 2009.

**References:**

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.

2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.

3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.

4. Introduction to Fiber Optics by Donald J.Sterling Jr. – Cengage learning, 2004.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE)– III-II Sem L T P C**

**0 0 3 1.5**

**(20A04601P) ANTENNAS &MICROWAVE ENGINEERING LAB**

**Course Objectives:**

* To understand the working, different microwave components and verify characteristics using microwave bench setup.
* To study various antennas

**Course Outcomes:**

At the end of this course, the students will be able to

* Understand the working, different microwave components and sources in a microwave bench
* Verify the characteristics of various microwave components using microwave bench setup
* Design and study of various antennas
* Analyze performance characteristics of Antennas

**Part-A Antennas Lab**

1. To analyze the characteristics of Simple Dipole λ/2 and λ/4 Antenna

2. To analyze the variation in the Radiation Strength at given distance from Antenna

3. To analyze the Reciprocity Theorem for Antennas

4. To study Folded Dipole λ /2 Antenna

5. Study of Yagi Uda 3 element Folded Dipole, 5 element folded dipole.

6. To analyze the characteristics of micro strip antennas

7. To analyze the characteristics and radiation pattern of broad side and end fire arrays.

**Part-B Microwave Engineering lab**

1. Reflex Klystron Characteristics.

2. Gunn Diode Characteristics.

3. Directional Coupler Characteristics.

4. VSWR Measurement.

5. Measurement of Wave Guide Parameters.

6. Measurement of Impedance of a given load.

7. Measurement of Scattering Parameters of a Magic Tee.

8. Measurement of Scattering Parameters of a Circulator.

9. Attenuation Measurement.

10. Microwave Frequency Measurement

NOTE: At least 5 Experiments from each section must be done in the semester.

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**(20A04602P) VLSI DESIGN LAB**

**Course Outcomes:**

* Design any logic circuit using CMOS transistor.
* Use different software tools for analysis of circuits.
* Design layouts to the CMOS circuits.
* Use different software tools for analog layout

**List of Experiments:**

1. Design and analysis of CMOS Inverter

a) Implement CMOS inverter schematic using 180 nm technology and design its symbol.

b) Implement test bench for CMOS Inverter and check its output response.

c) Perform DC and AC analysis for CMOS inverter.

d) Check the performance of CMOS inverter using parametric sweep.

1. Design and analysis of NAND and NOR Logic gates

a) Implement NAND/NOR schematic using 180 nm technology and design its symbol.

b) Implement test bench for NAND/NOR and check its output response.

c) Perform DC and AC analysis for NAND/NOR.

d) Check the performance of NAND/NOR using parametric sweep.

1. Design and analysis of XOR and XNOR Logic gates

a) Implement XOR/XNOR schematic using 180 nm technology and design its symbol.

b) Implement test bench for XOR/XNOR and check its output response.

c) Perform DC and AC analysis for XOR/XNOR.

d) Check the performance of XOR/XNOR using parametric sweep.

1. Design of AOI logic

a) Design Schematic for AB+C‘D and check its output response.

b) Design Schematic for AB‘+C‘D and check its output response.

c) Design Schematic for (A+B‘)(C+D) and check its output response.

d) Design Schematic for (A+B‘)(C‘+D) and check its output response.

1. Design and analysis of Full adder

a) Design full adder using Full custom IC design.

b) Design full adder using Semi custom IC design.

1. Analysis of NMOS and PMOS characteristics

a) Implement test bench for NMOS/PMOS transistor.

b) Perform DC and AC analysis for NMOS/PMOS transistor

c) Check the performance of NMOS/PMOS transistor using parametric sweep.

1. Design and analysis of Common source amplifier

a) Implement CS amplifier schematic using 180 nm technology and design its symbol.

b) Implement test bench for CS amplifier and check its output response.

c) Perform DC and AC analysis for CS amplifier.

d) Check the performance of CS amplifier using parametric sweep.

1. Design and analysis of Common drain amplifier

a) Implement CD amplifier schematic using 180 nm technology and design its symbol.

b) Implement test bench for CD amplifier and check its output response.

c) Perform DC and AC analysis for CD amplifier.

d) Check the performance of CD amplifier using parametric sweep.

1. Design of MOS differential amplifier

a) Design differential amplifier schematic using 180 nm technology and its symbol.

b) Implement test bench for differential amplifier and check its output response.

c) Perform DC and AC analysis for differential amplifier.

d) Check the performance of differential amplifier using parametric sweep.

1. Design of two stage differential amplifier

a) Design two stage differential amplifier schematic using 180 nm technology and its symbol. b) Implement test bench for two stage differential amplifier and check its output response.

c) Perform DC and AC analysis for two stage differential amplifier.

d) Check the performance of two stage differential amplifier using parametric sweep.

1. Design of Inverter Layout

a) Design and implement inverter schematic.

b) Design the layout for inverter using 180 nm tech file.

c) Perform LVS for schematic and layout

d) Check and remove all DRC violations.

e) Extract parasitic R and C in layout.

1. Design of NAND/NOR Layout

a) Design and implement NAND/NOR schematic.

b) Design the layout for inverter using 180 nm tech file.

c) Perform LVS for schematic and layout

d) Check and remove all DRC violations.

e) Extract parasitic R and C in layout

Note: Any TEN of the experiments are to be conducted

The students are required to design the schematic diagrams using CMOS logic and to draw the layout diagrams to perform the experiments with the Industry standard EDA Tools.

Software Required: i. Mentor Graphics Software / Equivalent Industry Standard Software. ii. Personal computer system with necessary software to run the programs and to implement.

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**(20A04603P) DATA COMMUNICATION &NETWORKS LAB**

**Course Objectives:**

To introduce Computer Network laboratory and familiarize with the tools by simulating various aspects of networking.

**Course Outcomes:**

* Familiarize with the network simulation tools
* Usage of the network simulators to study the various aspects that effect network performance

**List of Experiments:**

Introduction to Computer Network laboratory

Introduction to Discrete Event Simulation

Discrete Event Simulation Tools - ns2/ns3, Omnet++

**Usage of the tool ns2/ns3 to:**

1. Simulate telnet and ftp between N sources - N sinks (N = 1, 2, 3).

Evaluate the effect of increasing data rate on congestion.

1. Simulating the effect of queueing disciplines on network performance - Random Early Detection/Weighted RED / Adaptive RED (This can be used as a lead up to DiffServ / IntServ later).
2. Simulate http, ftp and DBMS access in networks
3. Effect of VLAN on network performance –i) multiple VLANs and single router ii) multiple VLANs with separate multiple routers
4. Implementation of IP address configuration.
5. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
6. Implementation of a routing algorithm
7. Simulation of Congestion Control Algorithms
8. Simulating the effect of DiffServ / IntServ in routers on throughput enhancement.
9. Simulating the performance of wireless networks
10. Case Study I: Evaluating the effect of Network Components on Network Performance To Design and Implement LAN With Various Topologies and To Evaluate Network Performance Parameters for DBMS etc)
11. Case Study II: Evaluating the effect of Network Components on Network Performance To Design and Implement LAN Using Switch/Hub/Router As Interconnecting Devices For Two Different LANs and To Evaluate Network Performance Parameters.

NOTE: At least 10 Experiments out of the list must be done in the semester.

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**(20A04606) RF SYSTEM DESIGN**

**Skill Oriented Course – IV**

**Course Objectives:**

To be well-versed in functionalities of basic RF electronics utilized in the industry

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

* Verify the basic principles and design aspects involved in high frequency communication systems components
* Conduct the experiments on different high frequency components to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts.
* Design and develop RF components using microstrip technology
* Apply knowledge of basic RF Electronics for realizing any RF system.

**UNIT I**

**Basic Concepts in RF Design:** Introduce any RF design software and orient students with the tools of the laboratory. Practice the tool to use it for significant design.Introduction to RF Design, Time Variance and Nonlinearity, Effects of nonlinearity, Passive impedance transformation, Scattering parameters, impedance matching, L match, Pi match, T match, Passive IC Components- Resistors, capacitors Inductors, Schottky Diode, RF Switch.

**UNIT II**

**RF Power Amplifiers and Filters**: RF Power amplifier design examples, Gain equalizers, Voltage controlled oscillators, Phase locked loops, Linearized PLL models, PLL design examples, High frequency oscillators, Loop filters, lumped filter. LPF, HPF and BPF.

**UNIT III**

**LNA, VCO and Mixers:** General considerations, Problem of input matching, Low Noise Amplifiers design in various topologies, Gain Switching, Band Switching, Voltage Controlled Oscillators, Mixers-General considerations, Passive down conversion mixers, Active down conversion mixers, Up conversion mixers.

**UNIT IV**

**Microstrip transmission lines and discontinuities:** S parameters of a Microstrip Transmission Line, Smith Chart, Analysis of Microstrip Transmission Line standing wave patterns at various frequencies, Different types of Transmission lines like CPW, Microstrip and Co-axial cable. Different types of Microstrip discontinuities like Bend, T, Via, Gap etc., Microstrip Ring Resonator.

**List of Experiments**

(ADS/IE3D/HFSS or any similar/ equivalent tool may be used for the design)

1. Design of λ/2, λ/4 micro strip transmission line.
2. Design of microstrip inductor and capacitor
3. Design of impedance matching network
4. Design and Simulate a Schottky Diode and RF Switch.
5. Design and characterization of RF BJT Amplifier and LNA
6. Analyse and measure the gain of a Power Amplifier and equalise its gain using an Equalizer.
7. Design of low pass, high pass, band pass and band stop filter at RF
8. Design and characterization of RF Mixer
9. Design and characterization of VCO
10. Measure the S parameters of a Micro strip Transmission Line and plot the normalised impedance on a smith chart
11. Analysis of Microstrip Transmission Line standing wave pattern at various frequencies.
12. Study of different types of Transmission lines like CPW, Microstrip and Co-axial and find/measure its Insertion Loss (S21 and S12)
13. Study of different types of Microstrip discontinuities like Bend, T, Via , Gap etc and find/measure its Insertion loss.
14. Design and characterization of micro strip patch antennas
15. Determine the Bandwidth and Quality Factor of a Microstrip Ring Resonator.

**NOTE: Any TWELVE experiments are to be conducted**

**References:**

1. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, 2004
2. Reinhold Ludwig and PavelBretchko, “RF circuit design,” Pearson Education, 2007.
3. B.Razavi, “RF Microelectronics”, Pearson Education, 2012

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**B.Tech (ECE)– III-II Sem L T P C**

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| **(20A99601) INTELLECTUAL PROPERTY RIGHTS AND PATENTS**  **(Mandatory Non-Credit Course)** | | |
| **Course Objectives:**  This course introduces the student to the basics of Intellectual Property Rights, Copy Right Laws, Cyber Laws, Trade Marks and Issues related to Patents. The overall idea of the course is to help and encourage the student for startups and innovations | | |
| **Course Outcomes:**   * Understand IPR law& Cyber law * Discuss registration process, maintenance and litigations associated with trademarks * Illustrate the copy right law * Enumerate the trade secret law. | | |
| UNIT I  Introduction to Intellectual Property Law – Evolutionary past – Intellectual Property Law Basics – Types of Intellectual Property – Innovations and Inventions of Trade related Intellectual Property Rights – Agencies Responsible for Intellectual Property Registration – Infringement – Regulatory – Overuse or Misuse of Intellectual Property Rights –Compliance and Liability Issues.  **UNIT II**  Introduction to Copyrights – Principles of Copyright – Subject Matters of Copyright – Rights Afforded by Copyright Law –Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of performers – Copyright Formalities and Registration – Limitations – Infringement of Copyright – International Copyright Law-Semiconductor Chip Protection Act.  **UNIT III**  Introduction to Patent Law – Rights and Limitations – Rights under Patent Law – Patent Requirements – Ownership and Transfer – Patent Application Process and Granting of Patent – Patent Infringement and Litigation – International Patent Law – Double Patenting – Patent Searching – Patent Cooperation Treaty – New developments in Patent Law- Invention Developers and Promoters.  **UNIT IV**  Introduction to Trade Mark – Trade Mark Registration Process – Post registration procedures – Trade Mark maintenance – Transfer of rights – Inter parties Proceedings – Infringement – Dilution of Ownership of Trade Mark – Likelihood of confusion – Trade Mark claims – Trade Marks Litigation – International Trade Mark Law.  **UNIT V**  Introduction to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreement – Trade Secret Law – Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law.Introduction to Cyber Law – Information Technology Act – Cyber Crime and E-commerce – Data Security – Confidentiality – Privacy – International aspects of Computer and Online Crime.  **Textbooks:**   1. Deborah E.Bouchoux: “Intellectual Property”. Cengage learning, New Delhi 2. Kompal Bansal &Parishit Bansal “Fundamentals of IPR for Engineers”, BS Publications (Press) 3. Cyber Law. Texts & Cases, South-Western’s Special Topics Collections   **References:**   1. Prabhuddha Ganguli: ‘ Intellectual Property Rights” Tata Mc-Graw – Hill, New Delhi 2. Richard Stim: “Intellectual Property”, Cengage Learning, New Delhi. 3. R. Radha Krishnan, S. Balasubramanian: “Intellectual Property Rights”, Excel Books. New Delhi. 4. M. Ashok Kumar and Mohd. Iqbal Ali: “Intellectual Property Right” Serials Pub. | | |
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**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04701a) DSP PROCESSORS & ARCHITECTURES**

**(Professional Elective Course –III)**

**Course Objectives:**

* To describe unique features of Digital signal processing.
* To demonstrate various computational parameters of DSP devices.
* To introduce architectural improvements in programmable DSP devices.
* To expose to basic DSP algorithms.
* To outline DSP processors for developing various applications.

**Course Outcomes:**

* Summarize features of Digital Signal Processing
* Evaluate dynamic ranges and precision for the given DSP system
* Explain architectural features of DSP processors
* Analyze performance of DSP algorithms on programmable DSP platform for given application
* Select DSP processors for building real time applications

**UNIT I**

Introduction to Digital Signal Processing: A Digital signal processing system, the sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time invariant systems, Digital filters, Decimation and interpolation.

**UNIT II**

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of Error in DSP Implementation, A/D Conversion Errors, D/A Conversion Errors

**UNIT III**

Architecture for Programmable DSP Devices: DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Programmability and Program Execution, Speed Issues, Commercial Digital Signal Processing Devices, Data Addressing Modes of TMS320C54xx Processors, Memory space of TMS320C54xx Processors, TMS320C54xx Instructions and Programs

**UNIT IV**

Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, PID Controller, Adaptive Filters,2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Bit Reversed Index Generation, 4-point FFT Implementation on the TMS320C54xx, Computation of the Signal Spectrum .

**UNIT V**

Applications of Programmable DSP Devices: A DSP System, DSP Based Biotelemetry Receiver, A Speech Processing System, An Image Processing System.

**Textbooks:**

1. B. Venkataramani and M. Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TMH, 2002.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing, Thomson Publications, 2004.

**References:**

1. J.G.Proakis, Algorithms for Statistical Signal Processing, Pearson,2002.
2. Jonatham Stein, Digital Signal Processing, John Wiley, 2005.
3. K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, A Practical Approach to Digital Signal Processing. New Age International, 2006/2009
4. Lapsley et al., DSP Processor Fundamentals - Architectures & Features, S. Chand & Co.,2000

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**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04701b) INTRODUCTION TO INTERNET OF THINGS**

**(Professional Elective Course –III)**

**Course Objectives:**

Students will understand the concepts of Internet of Things and can able to build IoT applications.

**Course Outcomes:**

* Understand the concepts of Internet of Things
* Identify hardware and software components of Internet of Things
* Analyze basic communication protocols
* Design IoT applications in different domain and be able to analyze their performance

**UNIT 1**

Introduction to IoT: Architectural overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals-Devices and gateways, Data management, Business processes in IoT, Role of cloud in IoT

**UNIT II**

Elements of IoT:Hardware components – computing (Arduino, Raspberry Pi), communication, Sensing, Actuation, I/O interfaces Software Components- Programming APIs (Using python/Arduino) for communication protocols-MQTT, Zigbee, Bluetooth, CoAP, UDP, TCP

**UNIT III**

Sensing and Actuation: Definition of Sensor, Sensor features, Resolution, Classes, Different types of sensors, Actuator, Different types of Actuators, purpose of Sensors and Actuators in IoT

**UNIT IV**

IoT Application Development: Solution frame work for IoT Applications-Implementation of Device integration, Data acquisition and Integration, Device data storage on cloud/local server, Authentication, authorization of Devices

**UNIT V**

IoT Case Studies: IoT Case studies and mini projects based on industrial Automation, Transportation, Agriculture, Healthcare, Home Automation.

**Textbooks**:

1. Vijay Madisetti, ArshdeepBahga, “Internet of Things a Hands-On- Approach”,2014.

**References:**

1. Dr SRN Reddy, RachitThukral and Manasi Mishra ,” Introduction to Internet of Things”: A practical Approach” ETI Labs
2. Raj Kamal , “ Internet of Things: Architecture and Design”, McGraw Hill
3. Adrian McEwen, “Designing the Internet of Things”, Wiley Publishers, 2013

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**3 0 0 3**

**(20A04701c) SATELLITE COMMUNICATIONS**

**(Professional Elective Course –III)**

**Course Objectives:**

To introduce various aspects in the design of systems for satellite communication.

**Course Outcomes:**

* Learn the dynamics of the satellite.
* Understand the communication satellite design.
* Understand how analog and digital technologies are used for satellite communication networks.
* Learn the design of satellite links.
* Study the design of Earth station and tracking of the satellites.

**UNIT I**

Elements of orbital mechanics. Equations of motion. Tracking and orbit determination. Orbital correction/control. Satellite launch systems. Multistage rocket launchers and their performance

**UNIT II**

Elements of communication satellite design. Spacecraft subsystems. Reliability considerations. Spacecraft integration.

**UNIT III**

Multiple access techniques. FDMA,TDMA,CDMA. Random access techniques. Satellite onboard processing.

**UNIT IV**

Satellite link design: Performance requirements and standards. Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite - based personal communication. links.

**UNIT V**

Earth station design. Configurations. Antenna and tracking systems. Satellite broadcasting.

**Textbooks:**

D. Roddy, Satellite Communication (4/e), McGraw- Hill, 2009.

T. Pratt & C.W. Bostain, Satellite Communication, Wiley 2000.

**References:**

B.N. Agrawal, Design of Geosynchrons Spacecraft, Prentice- Hall,1986

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**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04702a) REAL TIME OPERATING SYSTEMS**

**(Professional Elective Course –IV)**

**Course Objectives:**

* To introduce general idea, structure and functions of general purpose operating systems.
* To describe process & memory management techniques
* To teach concepts of how process is created and controlled with RTOs.
* To provide knowledge about the common problems in developing an RTOS.
* To discuss application development using RTOS

**Course Outcomes:**

* Describe real-time operating system requirements and design issues
* Illustrate role of operating systems in memory and I/O devices management
* Apply concepts of inter-task communication and synchronization via shared memory, message queues, signals, semaphores
* Examine challenges arising in design problems when developing embedded applications in multitasking systems
* Develop programs using system proved timers, signals, mutual exclusion, semaphores, message queues and exception handlers

**UNIT I**

Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems, Operating System services, user OS Interface, System Calls, Types of System Calls, System Programs, Opening System Design and Implementation, OS Structure, Virtual machines

**UNIT II**

Process Concept, Process Scheduling, Operations on Processes, Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors, Memory Management and Virtual Memory and File System Interface.

**UNIT III**

RTOs: Differences between General Purpose OS & RTOS, Real-time concepts, Hard Real time and Soft Real-time systems, Basic architecture of an RTOS, components in RTOS, kernel, objects, scheduler, Multitasking, context switch, Scheduling types, Task states, Task management. Kernel Objects, Semaphores, Synchronization between two tasks and multiple tasks, Single shared-resource-access synchronization, Recursive shared- resource- access synchronization, message queue, Common pipe, pipe operation, Select operation on multiple pipes, Pipes for inter-task Synchronization, Event register, control block, Signals, Catch operation, Execution sequence of wait and signal operations.

**UNIT IV**

RTOS Services Overview- TCP/IP protocol- Stack- File system- Remote procedure calls- RTOS command shell Exceptions and Interrupts- Programmable interrupt controller-Priority scheme- Task and stack Interrupt nesting- Interrupt processing in two contexts. Timer and Timer Services - Real-time clock Soft-timer- Servicing the timer interrupt in the task context- Timeout event handlers. I/O Subsystem and Memory Management Port-mapped I/O- Memory-mapped I/O- Write operation for a block-mode device- I/O function mapping- Associating devices with drivers-Memory allocation map, fragmentation, free operation, Management unit.

**UNIT V**

Typical RTOS Introduction to RT Linux, Real-Time Linux Applications in Embedded system, Common Design Problems - Deadlock, priority inversion problem, Embedded RTOS for fault-Tolerant applications

**Textbooks:**

1. Operating System Principles, Abraham Silberchatz, Peter B. Galvin, Greg Gagne 8th Edition, Wiley Student Edition.
2. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011

**References:**

1. Operating systems - Internals and Design Principles, W. Stallings, 6th Edition, Pearson.
2. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.

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**3 0 0 3**

**(20A04702b) DIGITAL IMAGE PROCESSING**

**(Professional Elective Course –IV)**

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| **Course Objectives:** | | |
| This course is designed to enable the students to familiarize themselves with basic concepts of digital image processing and different image transforms and learn various image processing techniques like image enhancement, restoration, segmentation and compression | | |
| **Course Outcomes:** | | |
| After completion of the course, students will be able to   * Perform image manipulations and different digital image processing techniques * Illustrate basic operations like – Enhancement, segmentation, compression, Image transforms and restoration techniques on image. * Analyze pseudo and full color image processing techniques. * Apply various morphological operators on images | | |
| **UNIT I** |  | Lecture 8Hrs |
| Introduction: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing. Image Transforms: Need for image transforms, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform, Importance of Phase, Walsh Transform. Hadamard transform, Haar Transform, Slant transform, Discrete Cosine transform, KL Transform, SVD and Radon Transform, Comparison of different image transforms. | | |
| **UNIT II** |  | Lecture 9Hrs |
| Intensity Transformations and Spatial Filtering: Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters , sharpening spatial filters, Combining spatial enhancement methods Filtering in the Frequency Domain: Preliminary concepts, The Basics of filtering in the frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering. | | |
| **UNIT III** |  | Lecture 9Hrs |
| Image Restoration and Reconstruction: A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering, constrained least squares filtering, geometric mean filter ,image reconstruction from projections. | | |
| **UNIT IV** |  | Lecture 8Hrs |
| Image compression: Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-Length coding, Symbol-Based coding, Bit-Plane coding, Block Transform coding, Predictive coding Wavelets and Multiresolution Processing: Image pyramids, subband coding, Multiresolution expansions, wavelet transforms in one dimensions & two dimensions, Wavelet coding. | | |
| **UNIT V** |  | Lecture 9Hrs |
| Image segmentation: Fundamentals, point, line, edge detection, thresholding, region –based segmentation. Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds.  Color image processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression. | | |
| **Textbooks:** | | |
| 1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.  2. Jayaraman, S. Esakkirajan, and T. Veerakumar,” Digital Image Processing”, Tata McGraw-Hill Education, 2011. | | |
| **Reference Books:** | | |
| 1. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 9th Edition, Indian Reprint, 2002.  2. B.Chanda, D.Dutta Majumder, “Digital Image Processing and Analysis”, PHI, 2009 | | |
| **Online Learning Resources:** | | |
| https://nptel.ac.in/courses/117105079  https://nptel.ac.in/courses/117105135 | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04702c) RADAR ENGINEERING**

**(Professional Elective Course –IV)**

**Course Objectives:**

* To make student to acquire the knowledge on types of Radars, working principles, tracking a target, applications and understand on phased array antennas, navigational aids

# Course Outcomes:

* Learn the basic working principle of Radar and target detection procedure
* Know the working and applications of CW and Frequency modulated Radar
* Gain the knowledge of about MTI and Pulse Doppler Radar
* Understand different methods of tracking a target and analyze the effect of noise at the receiver
* Learn about the phased array antennas and navigational aids

**UNIT I**

Basics of Radar: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Displays – types, Illustrative Problems.

**UNIT II**

**CW and Frequency Modulated Radar:** Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems.FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

**UNIT III**

**MTI and Pulse Doppler Radar:** Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, And Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

**UNIT IV**

**Tracking Radar:** Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two-coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

**Detection of Radar Signals in Noise:** Introduction, Noise Figure and Noise Temperature, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver.

**UNIT V**

**Phased Array Antennas and Navigational Aids:** Introduction to Phased Array Antennas- Basic Concepts, Electronically Steered Phased Array Antennas, Phase Shifters, Frequency – scan Arrays, Radiation for Phased Array, Architecture for Phased Arrays. Radiation Pattern. Beam Steering and Beam Width changes. Navigational Aids: Direction Finder, VOR, ILS and Loran

**Textbooks:**

1. Merrill I. Skolnik, “Introduction to Radar Systems”, 2nd Edition, TMH Special Indian Edition, 2007.
2. Byron Edde, “Radar Principals, Technology, Applications”, Pearson Education, 1992.

**References:**

1. F.E. Terman, Radio Engineering, Mc Graw Hill Book Co. (for Chapter 7 only), Fourth Edition 1955
2. Simon Kingsley & Shaun Quegan, Understanding RADAR Systems, McGraw Hill Book Co., 1993.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04703a) SMART SENSORS**

**(Professional Elective Course –V)**

**Course Objective:**

To make student to acquire the knowledge on types of sensors/transducers, working principles, selection procedure, applications of sensing systems

**Course Outcomes:**

* Understand measuring parameters, measuring systems, effects of environment, characteristics and parameters to be considered for designing an instrument
* Understand different types of sensors/transducers, working principles, selection procedure, applications of sensing systems
* Select a sensor/sensing system for a requirement
* Derive sensor-based solution for different applications.

**UNIT I**

Introduction to Measurement: Measurement units, applications, elements, choosing appropriate measuring instruments. Instrument Types and Performance Characteristics: Review of instrument types, Static characteristics, dynamic characteristics Error during measurement process: Sources of systematic error, reduction and quantification of systematic errors, random errors, aggregation of measurement system errors. Calibration: Calibration of measuring instruments, Primary calibration, secondary calibration and field calibration. Calibration methods for different parameters (temperature, pressure, humidity, flow...etc.). Automatic Calibration mechanisms.

**UNIT II**

Temperature Sensors: Thermo-resistive, Resistance Temperature Detectors, Silicon Resistive, Thermistors, Semiconductor, Optical, Acoustic, Piezoelectric

Humidity and Moisture Sensors: Capacitive, Electrical Conductivity, Thermal Conductivity, Optical Hygrometer, Time Domain Reflect meter.

Pressure and Force Sensors: Mercury Pressure, Bellows, Membranes, and Thin Plates, Piezoresistive, Capacitive, Optoelectronic, Vacuum, Strain Gauges, Tactile, Piezoelectric Force

**UNIT III**

Occupancy and Motion Detectors: Ultrasonic, Microwave Motion, Capacitive Occupancy, Visible and Near-Infrared Light, Far-Infrared Motion, PIR Motion, Position, Displacement, and Level Sensors: Potentiometric, Gravitational, Capacitive, Inductive and Magnetic, Optical, Ultrasonic, Radar Velocity and Acceleration Sensors: Capacitive Accelerometers, Piezoresistive Accelerometers, Piezoelectric Accelerometers, Thermal Accelerometers, Heated-Plate Accelerometer, Heated Gas Accelerometer, Gyroscopes, Piezoelectric Cables

**UNIT IV**

Flow Sensors: Pressure Gradient Technique, Thermal Transport, Ultrasonic, Electromagnetic, and Micro flow, Coriolis Mass Flow, Acoustic Sensors: Resistive Microphones, Fiber-Optic, Piezoelectric, Solid-State microphone, Light & Radiation Sensors: Photodiodes, Phototransistor, Photo resistors, Thermal detectors

Chemical Sensors: Metal-Oxide Chemical, ChemFET, Electro-chemical, Potentiometric, Conduct metric, Amperometric, Optical Chemical, Mass Detector

**UNIT V**

Introduction to wireless sensor networks, Challenges for wireless sensor networks, Applications for wireless sensor networks, enabling technologies for wireless sensor networks.

Single node architecture – Hardware components, Energy consumption of Sensor nodes (only Operation states with different power consumption, Relationship between computation and communication, Power consumption of sensor and actuators is included), Deployment environments

Sensor Network Architecture - Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, Gateway-concepts.

**Textbooks**

1. Measurement and Instrumentation Principles - Morris, AlanS
2. An Introduction to Error Analysis by John R.Taylor
3. Sensor Technology Handbook, John S.Wilson
4. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor
5. Networks” John-Wiley,First-Edition-2014.

References:

1. Mechanical Measurements – Beckwith, Marangoni,Lienhard
2. Measurement of Systems - Application and design - Earnest O.Doeblin
3. Electronic Instrumentation and Measurement Technique - Albert DHelfrick
4. Kazem Sohraby, Daniel Minoli, &TaiebZnati, “Wireless Sensor Networks- Technology,
5. Protocols, AndApplications”, John Wiley,2007.

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**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04703b) NANO ELECTRONICS**

**(Professional Elective Course -V)**

**Course Objectives**

* To teach nano electronic systems and its building blocks
* To provide knowledge on spin electronic devices.
* To familiarize students with the present research trend in Nano electronics

**Course Outcomes:**

* Describe the fabrication process and limitations in the CMOS design
* Choose different models of MOS devices according to the requirement.
* Integrate and model the device with basic quantum structures.
* Compare MOSFET, CNFET and Spin FET devices

**UNIT I**

Challenges going to sub-100 nm MOSFETs Oxide layer thickness, tunneling, power density, non-uniform dopant concentration, threshold voltage scaling, lithography, hot electron effects, sub-threshold current, velocity saturation, interconnect issues, fundamental limits for MOS operation.

**UNIT II**

Novel MOS-based devices Multiple gate MOSFETs, Silicon-on-insulator, Silicon-on-nothing, Fin FETs, vertical MOSFETs, strained Si devices.

**UNIT III**

Quantum structures quantum wells, quantum wires and quantum dots, Single electron devices charge quantization, energy quantization, Coulomb blockade, Coulomb staircase, Bloch oscillations.

**UNIT IV**

Hetero structure based devices Type I, II and III hetero junctions, Si-Ge hetero structure, hetero structures of III-V and II-VI compounds - resonant tunneling devices.

**UNIT V**

Carbon nanotubesbased devices CNFET, characteristics; Spin-based devices spin FET, characteristics, Applications of MOSFET, CNFET and Spin FET devcies.

**Textbooks:**

1. Mircea Dragoman and Daniela Dragoman, “ Nano electronics Principles & devices”, Artech House Publishers, 2005.
2. Karl Goser, “Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices”, Springer 2005.

**References:**

1. Mark Lundstrom and Jing Guo, “Nanoscale Transistors: Device Physics Modelling and Simulation”, Springer, 2005.
2. Vladimir VMitin, Viatcheslav A Kochelap and Michael A Stroscio, “Quantum hetero structures”, Cambridge University Press, 1999.
3. S M Sze (Ed), “High speed semiconductor devices”, Wiley, 1990.

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**B.Tech (ECE)– IV-I Sem L T P C**

**3 0 0 3**

**(20A04703c) CELLUAR & MOBILE COMMUNICATIONS**

**(Professional Elective Course –V)**

**Course Objectives:**

* To explain cell coverage for signal and traffic, diversity techniques and mobile antennas by the use of Engineering Mathematics.
* To present impairments due to multipath fading channel, fundamental techniques to overcome different fading effects, frequency management, Channel assignment and types of handoffs.
* To teach concepts and solve problems on mobile antennas and cellular systems.

**Course Outcomes:**

* Know about cell coverage for signal and traffic, diversity techniques and mobile antennas by the use of Engineering Mathematics
* Explain impairments due to multipath fading channel, fundamental techniques to overcome different fading effects, frequency management, Channel assignment and types of handoff
* Apply concepts to solve problems on mobile antennas and cellular systems
* Analyze Co-channel and Non Co-channel interferences, different Hand-offs and dropped call rates
* Evaluate performance of dropped call rate and false alarm rate
* Compare different handoffs

**UNIT I**

**Introduction to Cellular Mobile Radio Systems:** Limitations of Conventional Mobile Telephone Systems, Basic Cellular Mobile System, Uniqueness of Mobile Radio Environment, Mobile Fading Characteristics, Operations of Cellular Systems, Evolution of Cellular Systems.

**Fundamentals of Cellular Radio System Design**: Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I from a Normal Case in an Omni Directional Antenna System, System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems- CellSplitting, Sectoring, Microcell Zone Concept.

**UNIT II**

**Cell Coverage for Signal and Traffic:** Signal Reflections in Flat and Hilly Terrain, Effect of Human Made Structures, Phase Difference between Direct and Reflected Paths, Constant Standard Deviation, Straight Line Path Loss Slope, General Formula for Mobile Propagation Over Water and Flat Open Area, Near and Long Distance Propagation, Path Loss from a Point to Point Prediction Model in Different Conditions, Merits of Lee Model.

**Cell Site and Mobile Antennas:** Space Diversity Antennas, Umbrella Pattern Antennas, Minimum Separation of Cell Site Antennas, Mobile Antennas.

**UNIT III**

**Co-Channel Interference Reduction:** Measurement of Real Time Co-Channel Interference, Design of Omnidirectional and directional Antenna System, Antenna Parameters and Their Effects, Diversity Techniques-Space Diversity, Polarization Diversity, Frequency Diversity, Time Diversity.

**Non-Co-Channel Interference:** Adjacent Channel Interference, Near End Far End Interference, Cross Talk, Effects on Coverage and Interference by Power Decrease, Antenna Height Decrease, Effects of Cell Site Components.

**UNIT IV**

**Frequency Management and Channel Assignment:** Numbering and Grouping, Setup Access and Paging Channels, Channel Assignments to Cell Site and Mobile Units, Channel Sharing and Borrowing, Sectorization, Overlaid Cells, Non Fixed Channel Assignment.

**UNIT V**

**Handoffs and Dropped Calls:** Handoff Initiation, Types of Handoff, Delaying Handoff, Advantages of Handoff, Power difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoffs, Intersystem Handoff, Introduction to Dropped Call Rates and their Evaluation.

**System Evaluation:** Performance Evaluation, Blockage, Dropped-call rate, Signaling Evaluation- False Alarm Rate, Word error rate consideration and calculations, Measurement of averaged received signal level and level crossings.

**Textbooks:**

1. W.C.Y. Lee, Mobile Cellular Telecommunications, McGraw Hill, 2nd Edn., 1989.
2. Theodore. S. Rapport, Wireless Communications, Pearson Education, 2nd Edn., 2002.

**References:**

1. W.C.Y Lee, Mobile Communications Engineering-Theory and Applications, McGraw Hill, Second Edition, ,2014.
2. Gordon L. Stuber, Principles of Mobile Communications, Springer International, 2nd Edn., 2001.
3. Simon Haykin, Michael Moher, Modern Wireless Communications, Pearson Education, 2005.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE)– III-II Sem L T P C**

**3 0 0 3**

**(20A52701a) ENTREPRENEURSHIP & INCUBATION**

**(HUMANITIES ELECTIVE II)**

**Course Objectives:**

* To make the student understand about Entrepreneurship
* To enable the student in knowing various sources of generating new ideas in setting up of New enterprise
* To facilitate the student in knowing various sources of finance in starting up of a business
* To impart knowledge about various government sources which provide financial assistance to entrepreneurs/ women entrepreneurs
* To encourage the student in creating and designing business plans

**Course Outcomes:**

* Understand the concept of Entrepreneurship and challenges in the world of competition.
* Apply the Knowledge in generating ideas for New Ventures.
* Analyze various sources of finance and subsidies to entrepreneur/women Entrepreneurs.
* Evaluate the role of central government and state government in promoting Entrepreneurship.
* Create and design business plan structure through incubations.

**UNIT I**

Entrepreneurship - Concept, knowledge and skills requirement - Characteristics of successful entrepreneurs - Entrepreneurship process - Factors impacting emergence of entrepreneurship - Differences between Entrepreneur and Intrapreneur - Understanding individual entrepreneurial mindset and personality - Recent trends in Entrepreneurship.

**UNIT II**

Starting the New Venture - Generating business idea – Sources of new ideas & methods of generating ideas - Opportunity recognition - Feasibility study - Market feasibility, technical/operational feasibility - Financial feasibility - Drawing business plan - Preparing project report - Presenting business plan to investors.

**UNIT III**

Sources of finance - Various sources of Finance available - Long term sources - Short term sources - Institutional Finance – Commercial Banks, SFC's in India - NBFC's in India - their way of financing in India for small and medium business - Entrepreneurship development programs in India - The entrepreneurial journey- Institutions in aid of entrepreneurship development

**UNIT IV**

Women Entrepreneurship - Entrepreneurship Development and Government - Role of Central Government and State Government in promoting women Entrepreneurship - Introduction to various incentives, subsidies and grants – Export- oriented Units - Fiscal and Tax concessions available - Women entrepreneurship - Role and importance - Growth of women entrepreneurship in India - Issues & Challenges - Entrepreneurial motivations.

**UNIT V**

Fundamentals of Business Incubation - Principles and good practices of business incubation- Process of business incubation and the business incubator and how they operate and influence the Type/benefits of incubators - Corporate/educational / institutional incubators - Broader business incubation environment - Pre-Incubation and Post - Incubation process - Idea lab, Business plan structure - Value proposition

**Textbooks:**

1. D F Kuratko and T V Rao, “Entrepreneurship**”** - A South-Asian Perspective – Cengage Learning, 2012. (For PPT, Case Solutions Faculty may visit : login.cengage.com)
2. Nandan H, “ Fundamentals of Entrepreneurship”, PHI, 2013

**References:**

1. Vasant Desai, “Small Scale Industries and Entrepreneurship”, Himalaya Publishing 2012.
2. Rajeev Roy “Entrepreneurship”, 2nd Edition, Oxford, 2012.
3. B.JanakiramandM.Rizwana‖ “Entrepreneurship Development: Text & Cases”, Excel Books, 2011.
4. Stuart Read, Effectual “Entrepreneurship”, Routledge, 2013.

**E-Resources**

1. Entrepreneurship-Through-the-Lens-of-enture Capital
2. http://www.onlinevideolecture.com/?course=mba-programs&subject=entrepreneurship
3. http://nptel.ac.in/courses/122106032/Pdf/7\_4.pd
4. http://freevideolectures.com/Course/3514/Economics-/-Management-/-Entrepreneurhip/50

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**B.Tech (ECE)– III-II Sem L T P C**

**3 0 03**

**(20A52701b) MANAGEMENT SCIENCE**

**(HUMANITIES ELECTIVE-II)**

**Course Objectives:**

* To provide fundamental knowledge on Management, Administration, Organization & its concepts.
* To make the students understand the role of management in Production
* To impart the concept of HRM in order to have an idea on Recruitment, Selection,Training& Development, job evaluation and Merit rating concepts
* To create awareness on identify Strategic Management areas & the PERT/CPM for better Project Management
* To make the students aware of the contemporary issues in management

**Course Outcomes:**

* Understand the concepts & principles of management and designs of organization in a practical world
* Apply the knowledge of Work-study principles & Quality Control techniques in industry
* Analyze the concepts of HRM in Recruitment, Selection and Training & Development.
* Evaluate PERT/CPM Techniques for projects of an enterprise and estimate time & cost of project & to analyze the business through SWOT.
* Create Modern technology in management science.

**UNITI** I**NTRODUCTION TO MANAGEMENT**

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor’s Scientific Theory-Henry Fayol’s principles - Eltan Mayo’s Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization - Social responsibilities of Management.

**UNIT II OPERATIONS MANAGEMENT**

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), Work Study - Statistical Quality Control- Deming‘s contribution to Quality. **Material Management -** Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - **Marketing Management -** Concept - Meaning - Nature-Functions of Marketing - Marketing Mix - Channels of Distribution - Advertisement and Sales Promotion - Marketing Strategies based on Product Life Cycle.

**UNIT IIIHUMAN RESOURCES MANAGEMENT (HRM)**

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods - Performance Appraisal Concept - Methods of Performance Appraisal – Placement - Employee Induction - Wage and Salary Administration

**UNIT IV STRATEGIC & PROJECT MANAGEMENT**

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management -** Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Probability of Completing the project within given time - Project Cost- Analysis - Project Crashing (Simple problems).

**UNIT V CONTEMPORARY ISSUES IN MANAGEMENT**

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - Customer Relations Management(CRM) - Total Quality Management (TQM) - Six Sigma Concept - Supply Chain Management(SCM) - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking - Balanced Score Card - Knowledge Management.

**Textbooks:**

1. A.R Aryasri, “Management Science”, TMH, 2013

2. Stoner, Freeman, Gilbert, Management, Pearson Education, New Delhi, 2012.

**References:**

1. Koontz &Weihrich, “Essentials of Management”, 6th edition, TMH, 2005.

2. Thomas N.Duening& John M.Ivancevich, “Management Principles and Guidelines”, Biztantra.

3. Kanishka Bedi, “Production and Operations Management”, Oxford University Press, 2004.

4. Samuel C.Certo, “Modern Management”, 9th edition, PHI, 2005

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE)– III-II Sem L T P C**

**3 0 03**

**(20A52701c) ENTERPRISE RESOURCE PLANNING**

**(HUMANITIES ELECTIVE-II)**

**Course Objectives:**

* To provide a contemporary and forward-looking on the theory and practice of Enterprise Resource Planning
* To enable the students in knowing the Advantages of ERP
* To train the students to develop the basic understanding of how ERP enriches the
* Business organizations in achieving a multidimensional growth.
* Impart knowledge about the historical background of BPR
* To aim at preparing the students, technologically competitive and make them ready to self-upgrade with the higher technical skills.

**Course Outcomes:**

* Understand the basic use of ERP Package and its role in integrating business functions.
* Explain the challenges of ERP system in the organization
* Apply the knowledge in implementing ERP system for business
* Evaluate the role of IT in taking decisions with MIS
* Create reengineered business processes with process redesign

**UNITI**

Introduction to ERP: Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM),

**UNITII**

Benefits of ERP: Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design-making Capability

**UNITIII**

ERP Implementation Lifecycle: Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post-implementation (Maintenance mode)

**UNITIV**

BPR: Historical background: Nature, significance and rationale of business process reengineering (BPR), Fundamentals of BPR. Major issues in process redesign: Business vision and process objectives, Processes to be redesigned, Measuring existing processes,

**UNITV**

IT in ERP: Role of information technology (IT) and identifying IT levers. Designing and building a prototype of the new process: BPR phases, Relationship between BPR phases. MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System.

**Textbooks:**

1. Pankaj Sharma. “Enterprise Resource Planning”. Aph Publishing Corporation, New Delhi, 2004.
2. Alexis Leon, “Enterprise Resource Planning”, IV Edition, Mc.Graw Hill, 2019

**References:**

1. Marianne Bradford “Modern ERP”, 3rd edition.

2. ERP making it happen Thomas f. Wallace and Michael

3. Directing the ERP Implementation Michael w pelphrey

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**B.Tech (ECE)– IV-I Sem L T P C**

**1 0 2 2**

**(20A04706) INDUSTRIAL IOT AND AUTOMATION**

**(Skill Oriented Course- V)**

**Course Objectives:**

To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.

**Learning Outcomes:**

* Discover key IIoT concepts including identification, sensors, localization, wireless protocols, data storage and security
* Explore IoT technologies, architectures, standards, and regulation
* Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices
* Examine technological developments that will likely shape the industrial landscape in the future
* Understand how to develop and implement own IoT technologies, solutions, and applications

**Course Syllabus**

**MODULE 1: Introduction & Architecture**

What is IIoT and connected world? the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

 Practice

 1. Introduction to Arduino, Introduction to raspberry Pi.

<https://www.youtube.com/watch?v=AQdLQV6vhbk>

**MODULE 2: IIOT Components**

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): What is sensor? Types of sensors, working principle of basicSensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11).Digital switch, Electro  Mechanical switches.

 Practice

1. Measurement of temperature & pressure values of the process using raspberry pi/node mcu.

2. Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.

3. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

**MODULE 3: Communication Technologies of IIoT**

Communication Protocols: IEEE 802.15.4, ZigBee, Bluetooth, BLE, NFC, RFIDIndustry standards communication technology (MQTT), wireless network communication.

 Practice

 1. Demonstration of MQTT communication.

**MODULE 4: Visualization and Data Types of IIoT**

Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

 Practice

1. Visualization of diverse sensor data using dashboard (part of IoT’s ‘control panel’)

2. Sending alert message to the user. ways to control and interact with your environment)

**MODULE 5: Retrieving Data**

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

 Practice

1. Device control using mobile Apps or through Web pages.

2. Machine to Machine communication.

**MODULE 6: Control & Supervisory Level of Automation**

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA).

Practice

1. Digital logic gates programming using ladder diagram.

2. Implementation of Boolean expression using ladder diagram.

3. Simulation of PLC to understand the process control concept.

**Projects:**

IIoT based smart energy meter

Smart Agriculture system

Automation using controller via Bluetooth

Temperature controlled Fan/cooler using controller

Automatic streetlight

Smart Baggage Tracker

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**Textbooks**

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.)   (Springer Publication)
2. Industrial Internet of Things: Cybermanufacturing System**,**Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)

**OPEN ELECTIVES**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-I Sem L T P C**

**3 0 0 3**

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| **(20A01505) BUILDING TECHNOLOGY**  **(Open Elective-I)** | | |
| **Course Objectives:** | | |
| * To know different types of buildings, principles and planning of the buildings. * To identify the termite control measure in buildings, and importance of grouping circulation, lighting and ventilation aspects in buildings. * To know the different modes of vertical transportation in buildings. * To know the utilization of prefabricated structural elements in buildings. * To know the importance of acoustics in planning and designing of buildings. | | |
| **Course Outcomes (CO):** | | |
| * Understand the principles in planning and design the buildings * To get different types of buildings, principles and planning of the buildings * To know the different methods of termite proofing in buildings. * Know the different methods of vertical transportation in buildings. * Know the implementation of prefabricated units in buildings and effect of earthquake on buildings. * Know the importance of acoustics in planning and designing of buildings. | | |
| **UNIT I** |  |  |
| Overview of the course, basic definitions, buildings-types-components-economy and design-principles of planning of buildings and their importance. Definitions and importance of grouping and circulation-lighting and ventilation-consideration of the above aspects during planning of building. | | |
| **UNIT II** |  |  |
| Termite proofing: Inspection-control measures and precautions-lighting protectionof buildings-general principles of design of openings-various types of fire protection measures to be considered while panning a building. | | |
| **UNIT III** |  |  |
| Vertical transportation in a building: Types of vertical transportation-stairs-different forms of stairs-planning of stairs-other modes of vertical transportation –lifts-ramps-escalators. | | |
| **UNIT IV** |  |  |
| Prefabrication systems in residential buildings-walls-openings-cupboards-shelves etc., planning and modules and sizes of components in prefabrication. Planning and designing of residential buildings against the earthquake forces, principles, seismic forces and their effect on buildings. | | |
| **UNIT V** |  |  |
| Acoustics –effect of noise –properties of noise and its measurements, principles of acoustics of building. Sound insulation-importance and measures. | | |
| **Textbooks:** | | |
| 1. Building construction by Varghese, PHI Learning Private Limited 2nd Edition 2015 2. Building construction by Punmia.B.C, Jain.A.K and Jain.A.K Laxmi Publications 11th edition 2016 | | |
| **Reference Books:** | | |
| 1. National Building Code of India, Bureau of Indian Standards 2. Building construction-Technical teachers training institute, Madras, Tata McGraw Hill. 3. Building construction by S.P.Arora and S.P.BrndraDhanpat Rai and Sons Publications, New Delh 2014 edition | | |
| <https://nptel.ac.in/courses/105102206>  https://nptel.ac.in/courses/105103206 | | |

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| **(20A02505) ELECTRIC VEHICLES**  **(Open Elective-I)** | |
| **Course Objectives:** | |
| * To get exposed to new technologies of battery electric vehicles, fuel cell electric vehicles * To get exposed to EV system configuration and parameters * To know about electro mobility and environmental issues of EVs * To understand about basic EV propulsion and dynamics * To understand about fuel cell technologies for EV and HVEs * To know about basic battery charging and control strategies used in electric vehicles | |
| **Course Outcomes:** | |
| * Understand and differentiate between conventional and latest trends in Electric Vehicles * Analyze various EV resources, EV dynamics and Battery charging * Apply basic concepts of EV to design complete EV system * Design EV system with various fundamental concepts | |
| **UNIT I INTRODUCTION TO EV SYSTEMS AND PARAMETERS** | |
| Past, Present and Future EV, EV Concept, EV Technology, State-of-the Art EVs, EV configuration, EV system, Fixed and Variable gearing, single and multiple motor drive, in-wheel drives, EV parameters: Weight, size, force and energy, performance parameters. | |
| **UNIT II EV AND ENERGY SOURCES** | |
| Electro mobility and the environment, history of Electric power trains, carbon emissions from fuels, green houses and pollutants, comparison of conventional, battery, hybrid and fuel cell electric systems | |
| **UNIT III EV PROPULSION AND DYNAMICS** |  |
| Choice of electric propulsion system, block diagram, concept of EV Motors, single and multi motor configurations, fixed and variable geared transmission, In-wheel motor configuration, classification, Electric motors used in current vehicle applications, Recent EV Motors, Vehicle load factors, vehicle acceleration. | |
| **UNIT IV FUEL CELLS** |  |
| Introduction of fuel cells, basic operation, model, voltage, power and efficiency, power plant system – characteristics, sizing, Example of fuel cell electric vehicle.  Introduction to HEV, brake specific fuel consumption, comparison of series, series-parallel hybrid systems, examples | |
| **UNIT V BATTERY CHARGING AND CONTROL** |  |
| **Battery charging:** Basic requirements, charger architecture, charger functions, wireless charging, power factor correction.  **Control:** Introduction, modelling of electromechanical system, feedback controller design approach, PI controllers designing, torque-loop, speed control loop compensation, acceleration of battery electric vehicle | |
| **Textbooks:**   1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001. 2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003. | |
| **Reference Books:** | |
| 1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2005. 2. li Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015. | |
| **Online Learning Resources:** .<https://onlinecourses.nptel.ac.in/noc22_ee53/preview> | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-I Sem L T P C**

**3 0 0 3**

**(20A03505) 3D PRINTING TECHNOLOGY**

**(Open Elective-I)**

**Course Objectives:**

* Familiarize techniques for processing of CAD models for rapid prototyping.
* Explain fundamentals of rapid prototyping techniques.
* Demonstrate appropriate tooling for rapid prototyping process.
* Focus Rapid prototyping techniques for reverse engineering.
* Train Various Pre – Processing, Processing and Post Processing errors in RP Processes.

**Course Outcomes:**

* Use techniques for processing of CAD models for rapid prototyping.
* Understand and apply fundamentals of rapid prototyping techniques.
* Use appropriate tooling for rapid prototyping process.
* Use rapid prototyping techniques for reverse engineering.
* Identify Various Pre – Processing, Processing and Post Processing errors in RP processes.

**UNIT I Introduction to 3D Printing**

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

**UNIT II Solid and Liquid Based RP Systems**

Working Principle, Materials, Advantages, Limitations and Applicationsof Fusion Deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Stereo lithography (SLA), Direct Light Projection System (DLP) and Solid Ground Curing (SGC).

**UNIT III Powder Based & Other RP Systems**

**Powder Based RP Systems:** Working Principle,Materials, Advantages, Limitations and Applications of Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS) and Electron Beam Melting (EBM).

**Other RP Systems:** Working Principle,Materials, Advantages, Limitations and Applications of Three Dimensional Printing (3DP), Ballastic Particle Manufacturing (BPM) and Shape Deposition Manufacturing (SDM).

**UNIT IV Rapid Tooling & Reverse Engineering**

**Rapid Tooling:** Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

**Reverse Engineering (RE):** Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

**UNIT V Errors in 3D Printing and Applications:**

Pre-processing, processing and post-processing errors, Part building errors in SLA, SLS, etc.

**Software:** Need for software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, Solid View, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

**Applications:** Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

**Textbooks:**

1. Chee Kai Chua and Kah Fai Leong, “3D Printing and Additive Manufacturing Principles and Applications” 5/e, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, Springer, 2/e, 2010.

**Reference Books:**

1. Frank W.Liou, “Rapid Prototyping & Engineering Applications”, CRC Press, Taylor & Francis Group, 2011.
2. Rafiq Noorani, **“**Rapid Prototyping: Principles and Applications in Manufacturing”, John Wiley&Sons, 2006.

**Online Learning Resources:**

* NPTEL Course on Rapid Manufacturing.
* https://nptel.ac.in/courses/112/104/112104265/
* https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
* https://slideplayer.com/slide/6927137/
* https://www.mdpi.com/2073-4360/12/6/1334
* https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf
* https://lecturenotes.in/subject/197
* https://www.cet.edu.in/noticefiles/258\_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
* https://www.vssut.ac.in/lecture\_notes/lecture1517967201.pdf
* <https://www.youtube.com/watch?v=NkC8TNts4B4>

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| **(20A05505a) JAVA PROGRAMMING**  **(Open Elective Course – I)** | | |
| **Course Objectives:** | | |
| * To understand object-oriented concepts and problem-solving techniques * To obtain knowledge about the principles of inheritance and polymorphism * To implement the concept of packages, interfaces, exception handling and concurrency mechanism. * To design the GUIs using applets and swing controls. * To understand the Java Database Connectivity Architecture | | |
| **Course Outcomes:** | | |
| * Solve real-world problems using OOP techniques. * Apply code reusability through inheritance, packages and interfaces * Solve problems using java collection framework and I/O classes. * Develop applications by using parallel streams for better performance and develop applets for web applications. * Build GUIs and handle events generated by user interactions and Use the JDBC API to access the database. | | |
| **UNIT I** | **Introduction** |  |
| Introduction to Object Oriented Programming, The History and Evolution of Java, Introduction to Classes, Objects, Methods, Constructors, this keyword, Garbage Collection, Data Types, Variables, Type Conversion and Casting, Arrays, Operators, Control Statements, Method Overloading, Constructor Overloading, Parameter Passing, Recursion, String Class and String handling methods | | |
| **UNIT II** | **Inheritance, Packages, Interfaces** |  |
| Inheritance: Basics, Using Super, Creating Multilevel hierarchy, Method overriding, Dynamic Method Dispatch, Using Abstract classes, Using final with inheritance, Object class,  Packages: Basics, Finding packages and CLASSPATH, Access Protection, Importing packages.  Interfaces: Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces. | | |
| **UNIT III** | **Exception handling, Stream based I/O** |  |
| Exception handling - Fundamentals, Exception types, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built-in exceptions, creating own exception subclasses.  Stream based I/O (java.io) – The Stream Classes-Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and Writing Files, Random access file operations, The Console class, Serialization, Enumerations, Autoboxing, Generics. | | |
| **UNIT IV** | **Multithreading, The Collections Framework** |  |
| Multithreading: The Java thread model, creating threads, Thread priorities, Synchronizing threads, Interthread communication.  The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collectionclasses- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque. Hashtable, Properties, Stack, Vector, String Tokenizer, Bit Set, Date, Calendar, Random, Formatter, Scanner. | | |
| **UNIT V Applet, GUI Programming with Swings, Accessing Databases with JDBC** | | |
| Applet: Basics, Architecture, Applet Skeleton, requesting repainting, using the status window, passing parameters to applets  GUI Programming with Swings – The origin and design philosophy of swing, components and containers, layout managers, event handling, using a push button, jtextfield, jlabel and image icon, the swing buttons, jtext field, jscrollpane, jlist, jcombobox, trees, jtable, An overview of jmenubar, jmenu and jmenuitem, creating a main menu, show message dialog, show confirmdialog, show input dialog, show option dialog, jdialog, create a modeless dialog.  Accessing Databases with JDBC:  Types of Drivers, JDBC Architecture, JDBC classes and Interfaces, Basic steps in developing JDBC applications, Creating a new database and table with JDBC. | | |
| **Textbooks:** | | |
| 1. Java The complete reference, 9th edition, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd. 2. Java How to Program, 10th Edition, Paul Dietel, Harvey Dietel, Pearson Education. | | |
| **Reference Books:** | | |
| 1. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education. 2. Core Java Volume – 1 Fundamentals, Cay S. Horstmann, Pearson Education. 3. Java Programming for core and advanced learners, Sagayaraj, Dennis, Karthik andGajalakshmi, University Press 4. Introduction to Java programming, Y. Daniel Liang, Pearson Education. 5. Object Oriented Programming through Java, P. Radha Krishna, University Press. 6. Programming in Java, S. Malhotra, S. Chaudhary, 2nd edition, Oxford Univ. Press. 7. Java Programming and Object-oriented Application Development, R.A. Johnson,   Cengage Learning. | | |
| **Online Learning Resources:** | | |
| <https://www.w3schools.com/java/java_oop.asp>  <http://peterindia.net/JavaFiles.html> | | |

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| **(20A05602T) ARTIFICIAL INTELLIGENCE**  **Open Elective Course - I** | |  |
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| |  |  |  | | --- | --- | --- | | **Course Objectives:** | | | | This course is designed to:   * Introduce Artificial Intelligence * Teach about the machine learning environment * Present the searching Technique for Problem Solving * Introduce Natural Language Processing and Robotics | | | | **Course Outcomes:** | | | | After completion of the course, students will be able to   * Apply searching techniques for solving a problem * Design Intelligent Agents * Develop Natural Language Interface for Machines * Design mini robots * Summarize past, present and future of Artificial Intelligence | | | | **UNIT I** | **Introduction** | Lecture 9Hrs | | **Introduction**: What is AI, Foundations of AI, History of AI, The State of Art.  **Intelligent Agents**: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents. | | | | **UNIT II** | **Solving Problems by searching** | Lecture 9 Hrs | | Problem Solving Agents, Example problems, Searching for Solutions, Uninformed Search Strategies, Informed search strategies, Heuristic Functions, Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continues Spaces, Searching with Nondeterministic Actions, Searching with partial observations, online search agents and unknown environments. | | | | **UNIT III** | **Reinforcement Learning & Natural Language Processing** | Lecture 8Hrs | | **Reinforcement Learning**: Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, applications of RL  **Natural Language Processing**: Language Models, Text Classification, Information Retrieval, Information Extraction. | | | | **UNIT IV** | **Natural Language for Communication** | Lecture 8 Hrs | | **Natural Language for Communication**: Phrase structure grammars, Syntactic Analysis, Augmented Grammars and semantic Interpretation, Machine Translation, Speech Recognition  **Perception**: Image Formation, Early Image Processing Operations, Object Recognition by appearance, Reconstructing the 3D World, Object Recognition from Structural information, Using Vision. | | | | **UNIT V** | **Robotics** | Lecture 10Hrs | | **Robotics**: Introduction, Robot Hardware, Robotic Perception, planning to move, planning uncertain movements, Moving, Robotic software architectures, application domains  **Philosophical foundations**: Weak AI, Strong AI, Ethics and Risks of AI, Agent Components, Agent Architectures, Are we going in the right direction, What if AI does succeed. | | | | **Textbooks:** | | | | * + - 1. Stuart J.Russell, Peter Norvig, “Artificial Intelligence A Modern Approach”, 3rd Edition, Pearson Education, 2019. | | | | **Reference Books:** | | | | 1. Nilsson, Nils J., and Nils Johan Nilsson. Artificial intelligence: a new synthesis. Morgan Kaufmann, 1998. 2. Johnson, Benny G., Fred Phillips, and Linda G. Chase. "An intelligent tutoring system for the accounting cycle: Enhancing textbook homework with artificial intelligence." Journal of Accounting Education 27.1 (2009): 30-39. | | | | **Online Learning Resources:** | | | | http://peterindia.net/AILinks.html  http://nptel.ac.in/courses/106106139/  https://nptel.ac.in/courses/106/105/106105152/ | | | | | |
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| **(20A12502) MOBILE APPLICATION DEVELOPMENT USINGANDROID**  **(Open Elective-I)** | | |
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| **Course Objectives:** | | |
| * Facilitate students to understand android SDK. * Help students to gain a basic understanding of Android application development. * Inculcate working knowledge of Android Studio development tool. | | |
| **Course Outcomes:** | | |
| * Identify various concepts of mobile programming that make it unique from programming for other platforms. * Evaluate mobile applications on their design pros and cons. * Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces. * Develop mobile applications for the Android operating system that use basic and advanced phone features. * Demonstrate the deployment of applications to the Android marketplace for distribution. | | |
| **UNIT I** | **Introduction and Mobile User Interface Design** |  |
| Introduction to Android: The Android Platform, Android SDK, Android Studio Installation, Android Installation, building you First Android application, Understanding Anatomy of Android Application, Android Manifest file. | | |
| **UNIT II** | **Activities, Intents and Android User Interface** |  |
| Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions | | |
| **UNIT III** | **Advanced User Interface and Data Persistence** |  |
| Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. | | |
| **UNIT IV** | **Android Services, Publishing Android Applications** |  |
| Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources. | | |
| **UNIT V** | **Android Databases** |  |
| Using Common Android APIs: Using Android Data and Storage APIs, managing data using SQLite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World. | | |
| **Textbooks:** | | |
| 1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011). 2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development," Wiley India, FirstEdition,2012. | | |
| **Reference Books:** | | |
| 1. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd 2. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd 3. Android Application Development All in one for Dummies by Barry Burd, Edition: I | | |
| **Online Learning Resources:** | | |
| 1. https://developer.android.com/ | | |

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**(20A27505) COMPUTER APPLICATIONS IN FOOD TECHNOLOGY**

**(Open Elective-1)**

**Course Objectives:**

* To know different software and applications in food technology.
* To understand the Chemical kinetics in food processing, Microbial distraction in thermal processing of food.
* To acquire knowledge on computer aided manufacturing and control of food machinery, inventory control, process control.

**Course Outcomes:**

* Students will gain knowledge on software in food technology, data analysis, Chemical kinetics, microbial distortion in thermal process
* Use of linear regression in analyzing sensory data, application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants.

**UNIT I**

Introduction to various software and their applications in food technology. Application of MS Excel to solve the problems of Food Technology, SPSS and JMP for data analysis, Pro-Engineering for design, Lab VIEW and SCADA for process control .

**UNIT II**

Chemical kinetics in food processing: Determining rate constant of zero order reaction First order rate constant and half-life of reactions. Determining energy of activation of vitamin degradation during food storage Rates of Enzymes catalyzed reaction. Microbial distraction in thermal processing of food. Determining decimal reduction time from microbial survival data, Thermal resistance factor, Z-values in thermal processing of food. Sampling to ensure that a lot is not contaminated with more than a given percentage Statistical quality control. Probability of occurrence in normal distribution. Using binomial distribution to determine probability of occurrence. Probability of defective items in a sample obtained from large lot

**UNIT III**

Sensory evaluation of food Statistical descriptors of a population estimated from sensory data obtained from a sample Analysis of variance**.** One factor, completely randomized design For two factor design without replication**.** Use of linear regression in analyzing sensory data. Mechanical transport of liquid food**.** Measuring viscosity of liquid food using a capillary tube viscometer . Solving simultaneous equations in designing multiple effect evaporator while using matrix algebra available in excel.

**UNIT I**V

Familiarization with the application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants, stating from the receiving of raw material up to the storage & dispatch of finished product.

**UNIT V**

Basic Introduction to computer aided manufacturing. Application of computers, instrumentation and control of food machinery, inventory control, process control etc.

**Recommended books:**

1. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis by R. Paul Singh, AP.
2. Manuals of MS Office.

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|  | **(20A54501) OPTIMIZATION TECHNIQUES**  **(Open Elective- I)** |  |  |  |  |
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| **Course Objectives:** | | | | | |
| This course enables the students to classify and formulate real-life problem for modeling as optimization problem, solving and applying for decision making. | | | | | |
| **Course Outcomes:** Student will be able to | | | | | |
| * formulate a linear programming problem and solve it by various methods. * give an optimal solution in assignment jobs, give transportation of items from sources to destinations. * identify strategies in a game for optimal profit. * implement project planning. | | | | | |
| **UNIT I** |  |  | | | |
| Introduction to operational research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method. | | | | | |
| **UNIT II** |  |  | | | |
| Transportation problems- assignment problems-Game theory. | | | | | |
| **UNIT III** |  |  | | | |
| CPM and PERT –Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations. | | | | | |
| **UNIT IV** |  |  | | | |
| Sequencing Problems-Replacement problems-Capital equipment- Discounting costs- Group replacement. | | | | | |
| **UNIT V** |  |  | | | |
| Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models- Single period inventory models with shortage cost. | | | | | |
| **Textbooks:** | | | | | |
| 1. Operations Research , S.D. Sharma. 2. Operations Research, An Introduction, Hamdy A. Taha, Pearson publishers. 3. Operations Research, Nita H Shah, Ravi M Gor, Hardik Soni, PHI publishers | | | | | |
| **Reference Books:** | | | | | |
| 1. Problems on Operations Research, Er. Prem kumargupta, Dr.D.S. Hira, Chand publishers 2. Operations Research, CB Gupta, PK Dwivedi, Sunil kumaryadav | | | | | |
| **Online Learning Resources:** | | | | | |
| <https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L2slides.pdf>  <https://slideplayer.com/slide/7790901/>  <https://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf> | | | | | |

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**B.Tech III-I Sem L T P C**

**3 0 0 3**

**(20A56501) MATERIALS CHARACTERIZATION TECHNIQUES**

**(Open Elective- I)**

**Course Objectives**:

* To provide an exposure to different characterization techniques.
* To enlighten the basic principles and analysis of different spectroscopic techniques.
* To explain the basic principle of Scanning electron microscope along with its limitations and applications.
* To identify the Resolving power and Magnification of Transmission electron microscope and its applications.
* To educate the uses of advanced electric and magnetic instruments for characterization.

**Course Outcomes**: At the end of the course the student will be able

* To explain the structural analysis by X-ray diffraction.
* To understand the morphology of different materials using SEM and TEM.
* To recognize basic principles of various spectroscopic techniques.
* To study the electric and magnetic properties of the materials.
* To make out which technique can be used to analyse a material

**UNIT I**

Structure analysis by Powder X-Ray Diffraction: Introduction, Bragg’s law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherrer and Williamson-Hall (W-H)  Methods, Small angle X-ray scattering (SAXS) (in brief).

**UNIT II**

Microscopy technique -1 –Scanning Electron Microscopy (SEM)

Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.

**UNIT III**

Microscopy Technique -2 - Transmission Electron Microscopy (TEM): Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.

**UNIT IV**

Spectroscopy techniques – Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

**UNIT V**

Electrical & Magnetic Characterization techniques: Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

**Textbooks:**

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods –Yang

Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008

2. Handbook of Materials Characterization -by Sharma S. K. - Springer

**References:**

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M.

McCash, Tata McGraw-Hill, 2008.

2. Elements of X-ray diffraction – Bernard Dennis Cullity& Stuart R Stocks, Prentice Hall, 2001

3. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods-[Yang Leng](https://www.wiley.com/en-us/search?pq=%7Crelevance%7Cauthor%3AYang+Leng)- John Wiley & Sons

4. **Characterization of Materials 2nd Edition, 3 Volumes-Kaufmann E N -John Wiley (Bp)**

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**B.Tech III-I Sem L T P C**

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**(20A51501) CHEMISTRY OF ENERGY MATERIALS**

**(Open Elective- I)**

**Course Objectives:**

* To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
* To understand the basic concepts of processing and limitations of fossil fuels and Fuel cells & their applications.
* To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method
* Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
* To understand and apply the basics of calculations related to material and energy flow in the processes.

**Course Outcomes**:

* Ability to perform simultaneous material and energy balances.
* Student learn about various electrochemical and energy systems
* Knowledge of solid, liquid and gaseous fuels
* To know the energy demand of world, nation and available resources to fulfill the demand
* To know about the conventional energy resources and their effective utilization
* To acquire the knowledge of modern energy conversion technologies
* To be able to understand and perform the various characterization techniques of fuels
* To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively

**UNIT I: Electrochemical Systems:** Galvanic cell, standard electrode potential, application of EMF, electrical double layer, dipole moments, polarization, Batteries-Lead-acid and Lithium ion batterie**s.**

**UNIT II: Fuel Cells:** Fuel cell working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency, Basic design of fuel cell,.

**UNIT III: Hydrogen Storage:** Hydrogen Storage, Chemical and Physical methods of hydrogen storage, Hydrogen Storage in metal hydrides, metal organic frame works (MOF), Carbon structures, metal oxide porous structures, hydrogel storage by high pressure methods. Liquifaction method.

**UNIT IV:Solar Energy:** Solar energy introduction and prospects, photo voltaic (PV) technology, concentrated solar power (CSP), Solar Fuels, Solar cells.

**UNIT V:** Photo and Photo electrochemical Conversions: Photochemical cells and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions.

**References:**

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins
4. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services and corporation)
5. Hand book of solar energy and applications by Arvind Tiwari and Shyam.
6. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
7. Hydrogen storage by Levine Klebonoff

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**B.Tech IV-I Sem L T P C**

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| **(20A01704) ENVIRONMENTAL ECONOMICS**  **(Open Elective Course - II)** | | |
| **Course Objectives:** | | |
| * To impart knowledge on sustainable development and economics of energy * To teach regarding environmental degradation and economic analysis of degradation * To inculcate the knowledge of economics of pollution and their management * To demonstrate the understanding of cost benefit analysis of environmental resources * To make the students to understand principles of economics of biodiversity | | |
| **Course Outcomes :** | | |
| After the completion of the course, the students will be able to know   * The information on sustainable development and economics of energy * The information regarding environmental degradation and economic analysis of degradation * The identification of economics of pollution and their management * The cost benefit analysis of environmental resources * The principles of economics of biodiversity | | |
| **UNIT I** |  |  |
| Sustainable Development: Introduction to sustainable development - Economy-Environment inter-linkages - Meaning of sustainable development - Limits to growth and the environmental Kuznets curve – The sustainability debate - Issues of energy and the economics of energy – Nonrenewable energy, scarcity, optimal resources, backstop technology, property research, externalities, and the conversion of uncertainty. | | |
| **UNIT II** |  |  |
| Environmental Degradation: Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation – Equi –marginal principle. | | |
| **UNIT - III** |  |  |
| Economics of Pollution: Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions – Managing pollution through market intervention: Taxes, subsidies and permits. | | |
| **UNIT IV** |  |  |
| Cost – Benefit Analysis: Economic value of environmental resources and environmental damage - Concept of Total Economic Value - Alternative approaches to valuation – Cost-benefit analysis and discounting. | | |
| **UNIT V** |  |  |
| Economics of biodiversity: Economics of biodiversity conservation - Valuing individual species and diversity of species -Policy responses at national and international levels. Economics of Climate Change – stern Report | | |
| **Textbooks:** | | |
| * + - 1. An Introduction to Environmental Economics by N. Hanley, J. Shogren and B. White Oxford University Press.(2001)       2. Blueprint for a Green Economy by D.W. Pearce, A. Markandya and E.B. Barbier Earthscan, London.(1989) | | |
| **Reference Books:** | | |
| * + - 1. Environmental Economics: An Elementary Introduction by R.K. Turner, D.W. Pearce and I. Bateman Harvester Wheatsheaft, London. (1994),       2. Economics of Natural Resources and the Environment by D.W. Pearce and R.K. Turner Harvester Wheat sheaf, London. (1990),       3. Environmental and Resource Economics: An Introduction by Michael S. Common and Michael Stuart 2ndEdition, Harlow: Longman.(1996),       4. Natural Resource and Environmental Economics by Roger Perman, Michael Common, Yue Ma and James Mc Gilvray 3rdEdition, Pearson Education.(2003), | | |
| **Online Learning Resources:**  <https://nptel.ac.in/courses/109107171> | | |
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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-II Sem L T P C**

**3 0 0 3**

**(20A02605) SMART ELECTRIC GRID**

**(Open Elective Course-II)**

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| **Course Objectives:** | | |
| * Understand recent trends in grids, smart grid architecture and technologies * Analyze smart substations * Apply the concepts to design smart transmission systems * Apply the concepts to design smart distribution systems | | |
| **Course Outcomes:** | | |
| * Understand trends in Smart grids, needs and roles of Smart substations * Design and Analyze Smart Transmission systems * Design and Analyze Smart Distribution systems * Analyze SCADA and DSCADA systems in practical working environment | | |
| **UNIT I** | **INTRODUCTION TO SMART GRID** |  |
| Working definitions of Smart Grid and Associated Concepts – Smart Grid Functions – Traditional Power Grid and Smart Grid – New Technologies for Smart Grid – Advantages – Indian Smart Grid – Key Challenges for Smart Grid | | |
| **UNIT II** | **SMART GRID TECHNOLOGIES** |  |
| Characteristics of Smart grid, Micro grids, Definitions, Drives, benefits, types of Micro grid, building blocks, Renewable energy resources, needs in smart grid, integration impact, integration standards, Load frequency control, reactive power control, case studies and test beds | | |
| **UNIT III** | **SMART SUBSTATIONS** |  |
| Protection, Monitoring and control devices, sensors, SCADA, Master stations, Remote terminal unit, interoperability and IEC 61850, Process level, Bay level, Station level, Benefits, role of substations in smart grid, Volt/VAR control equipment inside substation | | |
| **UNIT IV** | **SMART TRANSMISSION SYSTEMS** |  |
| Energy Management systems, History, current technology, EMS for the smart grid, Synchro Phasor Measurement Units (PMUs), Wide Area Monitoring Systems (WAMS), protection & Control (WAMPC), needs in smart grid, Role of WAMPC smart grid, Drivers and benefits, Role of transmission systems in smart grid | | |
| **UNIT V** | **SMART DISTRIBUTION SYSTEMS** |  |
| DMS, DSCADA, trends in DSCADA and control, current and advanced DMSs, Voltage fluctuations, effect of voltage on customer load, Drivers, objectives and benefits, voltage-VAR control, VAR control equipment on distribution feeders, implementation and optimization, FDIR - Fault Detection Isolation and Service restoration (FDIR),faults, objectives and benefits, equipment, implementation | | |
| **Textbooks:** | | |
| 1. Stuart Borlase, Smart Grids - Infrastructure, Technology and Solutions, CRC Press, 1e, 2013 2. Gil Masters, Renewable and Efficient Electric Power System, Wiley–IEEE Press, 2e, 2013. | | |
| **Reference Books:** | | |
| 1. A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and their Applications, Springer Edition, 2e, 2017. 2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2e, 2012. | | |
| **Online Learning Resources:** | | |
| 1. <https://onlinecourses.nptel.ac.in/noc22_ee82/preview> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A03605) NON – CONVENTIONAL SOURCES OF ENERGY**

**(Open Elective-II)**

**Course Objectives:**

* To explain concept of various forms of renewable energy
* To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications
* To analyse the environmental and cost economics of using renewable energy sources compared to fossil fuels*.*

**Course Outcomes:**

* Explain the basic concepts of solar radiation and solar collectors
* Develop Bio - Energy
* Explain the geothermal Energy
* Apply the principles of electrical technology to develop MHD power generator
* Utilize different wind parameters for design of rotor
* Make use of power curve for energy estimation

**UNIT I**

**Principles of Solar Radiation**:

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**UNIT II**

**Solar Energy Collection & Storage**

**Solar Energy Collection**: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**Solar Energy Storage and Applications**:

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications solar heating technique, solar distillation and drying, photovoltaic energy conversion.

**UNIT III**

**Wind Energy &Biomass**

**Wind Energy**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

**Biomass**: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

**UNIT IV**

**Geothermal Energy & Ocean Energy**

**Geothermal Energy**: Resources, types of wells, methods of harnessing the energy, potential in India.

**Ocean Energy**: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. **Tidal and wave energy:** Potential and conversion techniques, mini-hydel power plants, and their economics.

**UNIT V**

**Direct Energy Conversion**

Need for DEC, Carnot cycle, limitations, principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

**Textbooks:**

* + - 1. Tiwari and Ghosal, Renewable energy resources, Narosa Publishing House-2004.
      2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publications-1988.

**Reference Books:**

1. Twidell& Weir, Renewable Energy Sources, Routledge; 3/e, 2015.
2. Sukhatme S.P., Nayak.J.P, ‘Solar Energy – Principle of Thermal Storage and collection”, Tata McGraw Hill, 2008.
3. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, 2006.
4. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, 2010.
5. Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, Chelsea Green Publishing, 2004.
6. S.S. Rao, B.B. Parulekar, Energy Technology (Non Conventional, Renewable and Conventional), Khanna publications, 1994.

**Online Learning Resources:**

* https://nptel.ac.in/courses/103103206
* https://nptel.ac.in/courses/108108078
* https://onlinecourses.nptel.ac.in/noc21\_ph33/preview
* https://nptel.ac.in/courses/121106014
* https://mrcet.com/downloads/digital\_notes/EEE/31082020/IV-I%20SOLAR%20&%20WIND%20ELECTRICAL%20SYSTEMS%20DIGITAL%20NOTES%201.pdf
* <https://www.vssut.ac.in/lecture_notes/lecture1428910296.pdf>

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**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-II Sem L T P C**

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| **(20A05605a) PRINCIPLES OF OPERATING SYSTEMS**  **(Open Elective Course – II)** | | | | | |
| **Course Objectives:** | | | | | |
| * Understand basic concepts and functions of operating systems * Understand the processes, threads and scheduling algorithms. * Expose the students with different techniques of handling deadlocks * Provide good insight on various memory management techniques * Explore the concept of file-system and its implementation issues | | | | | |
| **Course Outcomes:** | | | | | |
| * Demonstrate and understand of computer systems and operating systems functions * Distinguish between process and thread and classify scheduling algorithms * Solve synchronization and deadlock problems * Compare various memory management schemes * Explain file systems concepts and i/o management | | | | | |
| **UNIT I** | **Introduction to Computer and Operating system** | | |  | |
| Computer Types, Functional Units, Basic Operational Concepts, Number Representation and Arithmetic Operations, Character Representation, Performance, Historical Perspective, Memory Locations and Addresses, Memory operations, Instructions and Instruction Sequencing, Addressing modes  Architecture Operating System Structure, Operations Process, Memory, Storage Management, Protection and Security Computing Environments Operating System Services User Operating System Interface System Calls Types System Programs OS Structure OS Generation System Boot. | | | | | |
| **UNIT II** | **Process, Threads and Scheduling** | | |  | |
| Process Concept Scheduling Operations on Processes Cooperating Processes Inter-Process Communication Threads - Multithreading Models -Thread Libraries- Threading Issues – Scheduling Criteria Scheduling Algorithms Algorithm Evaluation. | | | | | |
| **UNIT III** | **Process Synchronization and Deadlocks** | | |  | |
| The Critical-Section Problem Synchronization Hardware Mutex Locks -Semaphores Classic Problems of Synchronization Critical Regions Monitors Deadlocks System Model Deadlock Characterization Methods for Handling Deadlocks Deadlock Prevention Deadlock Avoidance Deadlock Detection Recovery from Deadlock. | | | | | |
| **UNIT IV** | **Memory Management** | | |  | |
| Introduction - Swapping Contiguous Memory Allocation Paging Segmentation- Structure of the Page Table - Virtual Memory- Background Demand Paging Copy on Write Page Replacement Allocation of Frames Thrashing. | | | | | |
| **UNIT V** | **Input/ Output and Files** | | |  | |
| Overview of Mass Storage Structure - Disk Structure - Disk Scheduling and Management-File System Interface File Concept - Access Methods -Directory and Disk Structure- Directory Implementation -Allocation Methods- I/O Systems I/O Hardware- Application I/O Interface - Kernel I/O Subsystem. | | | | | |
| **Textbooks:** | | | | | |
| 1. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012. 2. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating Systems Concepts, Ninth Edition, Wiley,2012. | | | | | |
| **Reference Books:** | | | | | |
| 1. William Stallings, Operating Systems: Internals and Design Principles, Ninth Edition, Prentice-Hall, 2018. 2. Andrew Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall, 2009. | | | | | |
| **Online Learning Resources:** | | | | | |
| <https://nptel.ac.in/courses/106/106/106106144/>  <http://peterindia.net/OperatingSystems.html> | | | | | |
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| **JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  **B.Tech III-II Sem L T P C**  **3 0 0 3**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **(20A05605b) FOUNDATIONS OF MACHINE LEARNING**  **Open Elective Course– II**   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  | | --- | --- | --- | | **Course Objectives:** | | | | * Acquire theoretical knowledge on setting hypothesis for pattern recognition. * Apply suitable machine learning techniques for data handling and to gain knowledge from it. * Evaluate the performance of algorithms and to provide solution for various real-world applications. | | | | **Course Outcomes (CO):** | | | | After completion of the course, students will be able to   1. Understand the characteristics of machine learning strategies. 2. Apply various supervised learning methods to appropriate problems. 3. Identify and integrate more than one technique to enhance the performance of learning. 4. Create probabilistic and unsupervised learning models for handling unknown pattern. 5. Analyse the co-occurrence of data to find interesting frequent patterns. 6. Pre-process the data before applying to any real-world problem and can evaluate its performance | | | | UNIT - I | **Introduction to Machine Learning** | Lecture 8Hrs | | What is machine learning, learning associations, classification, regression, unsupervised learning, reinforcement learning  Supervised Learning: learning a class from examples, learning multiple classes, model selection and generalization | | | | UNIT - II | **Parametric, Non-Parametric methods** | Lecture 9Hrs | | Parametric Methods: Introduction, maximum likelihood estimation, evaluating an estimator, parametric classification, regression, model selection procedures  Nonparametric Methods: Introduction, nonparametric density estimation: histogram estimator, kernel estimator, k-nearest neighbour estimator | | | | UNIT - III | **Multivariate Methods** | Lecture 9Hrs | | Multivariate Methods: Multivariate data, parameter estimation, estimation of missing values, multivariate normal distribution, multi variate classification | | | | UNIT - IV | **Dimensionality Reduction, Clustering** | Lecture 8Hrs | | Dimensionality Reduction: Introduction, subset selection, principal component analysis, singular value decomposition and matrix factorization  Clustering: Mixture densities, k-means clustering, expectation-maximization algorithm, mixtures of latent variables | | | | UNIT - V | **Deep Learning** | Lecture 8Hrs | | Deep Learning: Introduction, train multiple hidden layers, improving training convergence, regularization, convolution layers, tuning the network structure, learning sequences. | | | | Textbooks: | | | | 1. [EthemAlpaydin](https://mitpress.mit.edu/contributors/ethem-alpaydin), Introduction to Machine Learning, Fourth Edition, MIT Press, Fourth Edition, 2020 2. MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning”, MIT Press, 2012 | | | | Reference Books: | | | | 1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, 2019. 2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, 2nd Edition, CRC Press, 2015. 3. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014. | | | | Online Learning Resources: | | | | 1. <https://bloomberg.github.io/foml/> 2. https://d1rkab7tlqy5f1.cloudfront.net/EWI/Over%20de%20faculteit/Afdelingen/Intelligent%20Systems/Pattern%20Recognition%20Laboratory/PR/Reading%20Group/Foundations\_of\_Machine\_Learning.pdf | | | | | | |  |  |  | |  | | | |  |  |  | |  | | | |  |  |  | |  | | | |  |  |  | |  | | | |  | | | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (IT)– III-II Sem L T P C**

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| **(20A05605c) DATA ANALYTICS USING R**  **(Open Elective-II)**  **Course Objectives:** | | |
| * Facilitate students to understand R programming * Help students to gain a basic understanding of Data Analytics * Inculcate working knowledge of plotting | | |
| **Course Outcomes:** | | |
| * Identify and execute basic syntax and programs in R * Perform the Matrix operations using R built in functions * Apply nonnumeric values in vectors * Create the list and data frames * Exploit the graph using ggplot2. | | |
| **UNIT I** | **Introduction to R Programming** |  |
| History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes- Comments- Installing and Loading R Packages- Help Files and Function Documentation-Saving Work and Exiting R- Conventions- R for Basic Math- Arithmetic- Logarithms and Exponentials - E-Notation - Assigning Objects – Vectors - Creating a Vector-Sequences, Repetition, Sorting and Lengths – Subsetting and Element Extraction -Vector – Oriented Behavior. | | |
| **UNIT II** | **Matrices and Arrays** |  |
| Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions-Subsetting- Row, Column, and Diagonal Extractions- Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication-Matrix Inversion-Multidimensional Arrays-Subsets, Extractions and Replacements. | | |
| **UNIT III** | **Non-Numeric values** |  |
| Logical Values- Relational Operators- Characters- Creating a String- Concatenation- Escape Sequences-Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels- Combining and Cutting. | | |
| **UNIT IV** | **Lists and Data frames** |  |
| List of Objects - Component Access – Naming – Nesting - Data Frames - Adding Data Columns and Combining Data Frames – Logical Record Subsets – Some Special Values – Infinity – NaN – NA -NULL – Attributes – Object - Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions | | |
| **UNIT V** | **Basic Plotting** |  |
| Using plot with Coordinate Vectors-Graphical Parameters-Automatic Plot Types-Title and Axis Labels-Color-Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an ExistingPlot-ggplot2 Package-Quick Plot with qplot-Setting Appearance Constants with Geoms—Reading and Writing Files- R-Ready Data Sets- Contributed Data Sets- Reading in External Data Files- Writing Out Data Files and Plots-AdHoc Object Read/Write Operations | | |
| **Textbooks:** | | |
| 1. Tilman M. Davies, “The Book of R-A First Programming, Statistics” Library of Congress Cataloging-in-Publication Data, 2016. | | |
| **Reference Books:** | | |
| 1. Hadley Wickham, Garrett Grolemund,”R for Data Science”,Oreilly Publication,2017.  2. Roger D. Peng, “R Programming for Data Science” Lean Publishing, 2016.  3. Steven Keller, “R ProgrammingforBeginners”,CreateSpaceIndependentPublishingPlatform2016. | | |
| **Online Learning Resources:** | | |
| 1. <https://www.coursera.org/learn/data-analysis-r> 2. https://www.careers360.com/courses-certifications/data-analysis-with-r-courses-brpg | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-II Sem L T P C**

**3 0 0 3**

**(20A27605) FOOD REFRIGERATION AND COLD CHAIN MANAGEMENT**

**OPEN ELECTIVE II**

**Course Objectives:**

* To know the equipment available to store perishable items for a long time
* To understand to increase the storage life of food items

**Course Outcomes**

By the end of the course, the students will

* Understand various principles and theories involved in refrigeration systems
* Understand the different equipment useful to store the food items for a long period.
* Understand how to increase the storage life of food items

**UNIT I**

Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization; Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures;

**UNIT II**

Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry vs wet compression, throttling vs isentropic expansion), representation of vapor compression cycle on pressure- enthalpy diagram, super heating, sub cooling;

**UNIT III**

Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle; Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve;

**UNIT IV**

Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice; Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations; Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display;

**UNIT V**

Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling load calculations: Load sources, product cooling, conducted heat, convicted heat, internal heat sources, heat of respiration, peak load; etc.

**Textbooks:**

1. Arora, C. P. “Refrigeration and Air Conditioning”. Tata MC Graw Hill Publishing Co.Ltd., New Delhi. 1993.

**References:**

1. Adithan, M. and Laroiya, S. C. “Practical Refrigeration and Air Conditioning”. Wiley Estern Ltd., New Delhi 1991

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-II Sem L T P C**

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| **(20A54701) WAVELET TRANSFORMS AND ITS APPLICATIONS**  **(Open Elective-II)** | | |
| **Course Objectives:** | | |
| This course provides the students to understand Wavelet transforms and its applications. | | |
| **Course Outcomes:** | | |
| * Understand wavelets and wavelet expansion systems. * Illustrate the multi resolution analysis ad scaling functions. * Form fine scale to coarse scale analysis. * Find the lattices and lifting. * Perform numerical complexity of discrete wavelet transforms. * Find the frames and tight frames using fourier series. | | |
| **UNIT I** | Wavelets |  |
| Wavelets and Wavelet Expansion Systems - Wavelet Expansion- Wavelet Transform- Wavelet System- More Specific Characteristics of Wavelet Systems -Haar Scaling Functions and Wavelets -effectiveness of Wavelet Analysis -The Discrete Wavelet Transform the Discrete-Time and Continuous Wavelet Transforms. | | |
| **UNIT II** | A Multiresolution Formulation of Wavelet Systems |  |
| Signal Spaces -The Scaling Function -Multiresolution Analysis - The Wavelet Functions - The Discrete Wavelet Transform- A Parseval's Theorem - Display of the Discrete Wavelet Transform and the Wavelet Expansion. | | |
| **UNIT III** | Filter Banks and the Discrete Wavelet Transform |  |
| Analysis - From Fine Scale to Coarse Scale- Filtering and Down-Sampling or Decimating -Synthesis - From Coarse Scale to Fine Scale -Filtering and Up-Sampling or Stretching - Input Coefficients - Lattices and Lifting - -Different Points of View. | | |
| **UNIT IV** | Time-Frequency and Complexity |  |
| Multiresolution versus Time-Frequency Analysis- Periodic versus Nonperiodic Discrete Wavelet Transforms -The Discrete Wavelet Transform versus the Discrete-Time Wavelet Transform- Numerical Complexity of the Discrete Wavelet Transform. | | |
| **UNIT V** | Bases and Matrix Examples |  |
| Bases, Orthogonal Bases, and Biorthogonal Bases -Matrix Examples - Fourier Series Example - Sine Expansion Example - Frames and Tight Frames - Matrix Examples -Sine Expansion as a Tight Frame Example. | | |
| **Textbooks:** | | |
| 1. C. Sidney Burrus, Ramesh A. Gopinath, “Introduction to Wavelets and Wavelets Transforms”,Prentice Hall, (1997). 2. James S. Walker, “A Primer on Wavelets and their Scientific Applications”, CRC Press, (1999). | | |
| **Reference Books:** | | |
| 1. Raghuveer Rao, “Wavelet Transforms”, Pearson Education, Asia. | | |
| Online Learning Resources: | | |
| <https://www.slideshare.net/RajEndiran1/introduction-to-wavelet-transform-51504915> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-II Sem L T P C**

**3 0 0 3**

**(20A56701) PHYSICS OF ELECTRONIC MATERIALS AND DEVICES**

**(Open Elective-II)**

**Course Objectives:**

* To impart the fundamental knowledge on various materials, their properties and applications.
* To provide insight into various semiconducting materials, and their properties.
* To enlighten the characteristic behavior of various semiconductor devices.
* To provide the basics of dielectric and piezoelectric materials and their properties.
* To explain different categories of magnetic materials, mechanism and their advanced applications.

**Course Outcome:** At the end of the course the student will be able

* To understand the fundamentals of various materials.
* To exploit the physics of semiconducting materials
* To familiarize with the working principles of semiconductor-based devices.
* To understand the behaviour of dielectric and piezoelectric materials.
* To identify the magnetic materials and their advanced applications.

**UNIT I Fundamentals of Materials Science**

Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Basic idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RT and glow discharge).

**UNIT II Semiconductors**

Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

**UNIT III Physics of Semiconductor devices**

Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Construction and working principles of: Light emitting diodes, Heterojunctions, Transistors, FET and MOSFETs.

**UNIT IV Dielectric Materials and their applications:**

Introduction, Dielectric properties, Electronic polarizability and susceptibility, Dielectric constant and frequency dependence of polarization, Dielectric strength and dielectric loss, Piezoelectric properties.

**UNIT V Magnetic Materials and their applications**

Introduction, Magnetism & various contributions to para and dia magnetism, Ferro and Ferri magnetism and ferrites, Concepts of Spin waves and Magnons, Anti-ferromagnetism, Domains and domain walls, Coercive force, Hysteresis, Nano-magnetism, Super-paramagnetism – Properties and applications.

**Textbooks**

1. Principles of Electronic Materials and Devices- S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd., 3rd edition, 2007.
2. Electronic Components and Materials- Grover and Jamwal, Dhanpat Rai and Co.

#### Reference Books:

1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning, 6th edition
2. Electronic Materials Science- Eugene A. Irene, , Wiley, 2005
3. An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd., , 2nd Edition,2011
4. A First Course In Material Science- by Raghvan, McGraw Hill Pub.
5. The Science and Engineering of materials- Donald R.Askeland, Chapman& Hall Pub.

**NPTEL courses links**<https://nptel.ac.in/courses/113/106/113106062/>

<https://onlinecourses.nptel.ac.in/noc20_mm02/preview>, <https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-mm07>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech III-II Sem L T P C**

**3 0 0 3**

**(20A51701) CHEMISTRY OF POLYMERS AND ITS APPLICATIONS**

**Course Objectives:**

* To understand the basic principles of polymers
* To synthesize the different polymeric materials and their characterization by various instrumental methods.
* To impart knowledge to the students about fundamental concepts of Hydro gels of polymer networks, surface phenomenon by micelles
* To enumerate the applications of polymers in engineering

**Course Outcome**

* At the end of the course, the student will be able to:
* Understand the state of art synthesis of Polymeric materials
* Understand the hydro gels preparation, properties and applications in drug delivery system.
* Characterize polymers materials using IR, NMR, XRD.
* Analyze surface phenomenon fo micelles and characterise using photoelectron spectroscopy, ESCA and Auger spectroscopy

**UNIT I :** Polymers-Basics and Characterization

Basic concepts: monomers, repeat units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: condensation, addition, radical chain, ionic and coordination and copolymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution Measurement of molecular weight: end group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

**Unit II** : Synthetic Polymers Addition and condensation polymerization processes – Bulk, Solution, Suspension and Emulsion polymerization.

Preparation and significance, classification of polymers based on physical properties, Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications.

Preparation of Polymers based on different types of monomers, Olefin polymers, Diene polymers, nylons, Urea - formaldehyde, phenol - formaldehyde and melamine Epoxy and Ion exchange resins. Characterization of polymers by IR, NMR, XRD.

**UNIT III :** Natural Polymers & Modified cellulosics

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEAK.

Learning Outcomes:

**UNIT IV:** Hydrogels of Polymer networks and Drug delivery

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

Introduction to drug systems including, drug development, regulation, absorption and disposition, routes of administration and dosage forms. Advanced drug delivery systems and controlled release.

**UNIT V :** Surface phenomena

Surface tension, adsorption on solids, electrical phenomena at interfaces including electrokinetics, micelles, reverse micelles, solubilization. Application of photoelectron spectroscopy, ESCA and Auger spectroscopy to the study of surfaces.

**References :**

1. A Text book of Polymer science, Billmayer
2. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
3. Advanced Organic Chemistry, B.Miller, Prentice Hall
4. Polymer Chemistry – G.S.Mishra
5. Polymer Chemistry – Gowarikar
6. Physical Chemistry –Galston
7. Drug Delivery- Ashim K. Misra

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

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| --- | --- | --- |
| **(20A01705) COST EFFECTIVE HOUSING TECHNIQUES**  **(Open Elective Course - III)** | | |
| **Course Objectives:** | | |
| * To understand the requirements of structural safety for future construction. * To know about the housing scenario, housing financial systems land use and physical * planning for housing and housing the urban poor * To know the traditional practices of rural housing * To know the different innovative cost effective construction techniques * To know the alternative building materials for low cost housing. | | |
| **Course Outcomes :** | | |
| * To know the repair and restore action of earthquake damaged non engineered buildings and ability to understand the requirements of structural safety for future construction * To know about the housing scenario, housing financial systems land use and physical planning for housing and housing the urban poor * Apply the traditional practices of rural housing * Understand the different innovative cost effective construction techniques * Suggest the alternative building materials for low cost housing | | |
| **UNIT I** |  |  |
| 1. **Housing Scenario :**Introducing - Status of urban housing - Status of Rural Housing 2. **Housing Finance**: Introducing - Existing finance system in India - Government role as facilitator - Status at Rural Housing Finance - Impedimently in housing finance and related issues 3. **Land use and physical planning for housing :**Introduction - Planning of urban land - Urban land ceiling and regulation act - Efficiency of building bye lass - Residential Densities 4. **Housing the urban poor :**Introduction - Living conditions in slums - Approaches and strategies for housing urban poor | | |
| **UNIT II** |  |  |
| **Development and adoption of low cost housing technology**  Introduction - Adoption of innovative cost effective construction techniques - Adoption of precast elements in partial prefatroices - Adopting of total prefactcation of mass housing in India- General remarks on pre cast rooting/flooring systems -Economical wall system - Single Brick thick loading bearing wall - 19cm thick load bearing masonry walls - Half brick thick load bearing wall – Fly-ash gypsum thick for masonry - Stone Block masonry - Adoption of precast R.C. plank and join system for roof/floor in the building | | |
| **UNIT III** |  |  |
| **Alternative building materials for low cost housing**  Introduction - Substitute for scarce materials – Ferro-cement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - alternative building maintenance  **Low cost Infrastructure services:**  Introduce - Present status - Technological options - Low cost sanitation - Domestic wall - Water supply, energy | | |
| **UNIT IV** |  |  |
| **Rural Housing:** Introduction traditional practice of rural housing continuous - Mud Housing technology Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs | | |
| **UNIT V** |  |  |
| **Housing in Disaster prone areas:**  Introduction – Earthquake - Damages to houses - Traditional prone areas - Type of Damages and Railways of non-engineered buildings - Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions. Requirement’s of structural safety of thin precast roofing units against Earthquake forces Status of R& D in earthquake strengthening measures - Floods, cyclone, future safety | | |
| **Textbooks:** | | |
| 1. Building materials for low – income houses – International council for building research studies and documentation. 2. Hand book of low cost housing by A.K.Lal – Newage international publishers. 3. Low cost Housing – G.C. Mathur by South Asia Books | | |
| **Reference Books:** | | |
| 1. Properties of concrete – Neville A.m. Pitman Publishing Limited, London. 2. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences 1963. 3. Modern trends in housing in developing countries – A.G. Madhava Rao, D.S. Rama chandra Murthy &G.Annamalai. E. & F. N. Spon  Publishers | | |
| **Online Learning Resources:** | | |
| <https://nptel.ac.in/courses/124107001> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

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| **(20A02704) IoT APPLICATIONS IN ELECTRICAL ENGINEERING**  **(Open Elective Course – III)** | | | |
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| **Course Objectives:** | | | |
| * Understand basics of Internet of Things and Micro Electro Mechanical Systems (MEMS) fundamentals in design and fabrication process * Analyze motion less and motion detectors in IoT applications * Understand about Analyze applications of IoT in smart grid * Apply the concept of Internet of Energy for various applications | | | |
| **Course Outcomes:** | | | |
| * Understand the concept of IoT in Electrical Engineering * Analyze various types of motionless sensors and various types of motion detectors * Apply various applications of IoT in smart grid * Design future working environment with Energy internet | | | |
| **UNIT I** | **SENSORS** | |  |
| Definitions, Terminology, Classification, Temperature sensors, Thermoresistive, Resistance, temperature detectors, Silicon resistive thermistors, Semiconductor, Piezoelectric, Humidity and moisture sensors. Capacitive, Electrical conductivity, Thermal conductivity, time domain reflectometer, Pressure and Force sensors: Piezoresistive, Capacitive, force, strain and tactile sensors, Strain gauge, Piezoelectric | | | |
| **UNIT II** | **OCCUPANCY AND MOTION DETECTORS** | |  |
| Capacitive occupancy, Inductive and magnetic, potentiometric - Position, displacement and level sensors, Potentiometric, Capacitive, Inductive, magnetic velocity and acceleration sensors, Capacitive, Piezoresistive, piezoelectric cables, Flow sensors, Electromagnetic, Acoustic sensors - Resistive microphones, Piezoelectric, Photo resistors | | | |
| **UNIT III** | **MEMS** | |  |
| Basic concepts of MEMS design, Beam/diaphragm mechanics, electrostatic actuation and fabrication, Process design of MEMS based sensors and actuators, Touch sensor, Pressure sensor, RF MEMS switches, Electric and Magnetic field sensors | | | |
| **UNIT IV** | **IoT FOR SMART GRID** | |  |
| Driving factors, Generation level, Transmission level, Distribution level, Applications, Metering and monitoring applications, Standardization and interoperability, Smart home | | | |
| **UNIT V INTERNET of ENERGY (IoE)**  Concept of Internet of Energy, Evaluation of IoE concept, Vision and motivation of IoE, Architecture, Energy routines, information sensing and processing issues, Energy internet as smart grid | | | |
| **Textbooks:** | | | |
| 1. Jon S. Wilson, Sensor Technology Hand book, Newnes Publisher, 2004 2. Tai Ran Hsu, MEMS and Microsystems: Design and manufacture, 1st Edition, Mc Grawhill Education, 2017 3. Ersan Kabalci and Yasin Kabalci, From Smart grid to Internet of Energy, 1st Edition, Academic Press, 2019 | | | |
| **Reference Books:** | | | |
| 1. Raj Kumar Buyya and Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, Kindle Edition, Morgan Kaufmann Publisher, 2016 2. Yen Kheng Tan and Mark Wong, Energy Harvesting Systems for IoT Applications: Generation, Storage and Power Management, 1st Edition, CRC Press, 2019 3. RMD Sundaram Shriram, K. Vasudevan and Abhishek S. Nagarajan, Internet of Things, Wiley, 2019 | | | |
| **Online Learning Resources:** | | | |
| 1.<https://onlinecourses.nptel.ac.in/noc22_cs96/preview>  2. <https://nptel.ac.in/courses/108108123>  3. <https://nptel.ac.in/courses/108108179> | | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A03704) INTRODUCTION TO HYBRID AND ELECTRICAL VEHICLES**

**(Open Elective-III)**

**Course Objectives:**

* Provide good foundation on hybrid and electrical vehicles.
* To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles.
* Familiarize energy storage systems for electrical and hybrid transportation.
* To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

**Course Outcomes:**

* Explain the working of hybrid and electric vehicles
* Choose a suitable drive scheme for developing an hybrid and electric vehicles depending on resources
* Develop the electric propulsion UNIT and its control for application of electric vehicles
* Choose proper energy storage systems for vehicle applications
* Design and develop basic schemes of electric vehicles and hybrid electric vehicles

**UNIT I Electric Vehicle Propulsion and Energy Sources**

Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge, specific energy, specific power, Ragone plot. Battery modelling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Li-polymer battery.

**UNIT II Electric Vehicle Power Plant and Drives**

Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.

**UNIT III Hybrid and Electric Drive Trains**

Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies. Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

**UNIT IV Electric and Hybrid Vehicles - Case Studies**

Parallel hybrid, series hybrid -charge sustaining, charge depleting. Hybrid vehicle case study –Toyota Prius, Honda Insight, Chevrolet Volt. 42 V systems for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev. Hybrid electric heavy-duty vehicles, fuel cell heavy duty vehicles.

**UNIT V Electric and Hybrid Vehicle Design**

Introduction to hybrid vehicle design. Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem. Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

**Textbooks:**

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2/e, CRC Press, 2003.
2. Amir Khajepour, [M. Saber Fallah](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22M.+Saber+Fallah%22&source=gbs_metadata_r&cad=4), [AvestaGoodarzi](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Avesta+Goodarzi%22&source=gbs_metadata_r&cad=4), Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, illustrated edition, John Wiley & Sons, 2014.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

**Reference Books:**

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. John G. Hayes, [G. Abas Goodarzi](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=G.+Abas+Goodarzi&search-alias=stripbooks), Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 1/e, Wiley-Blackwell, 2018.

**Online Learning Resources:**

* https://archive.nptel.ac.in/courses/108/103/108103009/
* https://www.youtube.com/watch?v=wypbLRe9xUg
* https://www.youtube.com/watch?v=q6BYr5-fq5U
* https://www.youtube.com/watch?v=3E1SXG7VkQk
* https://www.iare.ac.in/sites/default/files/IARE\_HEV\_LN\_0.pdf
* <https://nptel.ac.in/courses/108102121>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A05704) WEB TECHNOLOGIES**

**(Open Elective-III)**

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| **Course Objectives:** | | |
| The course is designed to Introduce the key technologies that have been developed as part of the birth and maturation of the World Wide Web. | | |
| **Course Outcomes:** | | |
| * Understand the Web essentials. * Develop web pages using XHTML * Apply style to web pages using CSS * Write scripts for client side * Develop and transform XML documents. | | |
| **UNIT I** | **Web Essentials: Clients, Servers, and Communication** |  |
| The Internet, Basic Internet protocols, WWW, HTTP request message, HTTP response message, Web clients, Web Servers, Case study. | | |
| **UNIT II** | **Markup Languages: XHTML 1.0** |  |
| An introduction to HTML, Basic XHTML syntax and semantics, fundamental HTML elements, Relative URLs, Lists, Tables, Frames, Forms, Defining XHTML’s abstract syntax, Creating HTML documents. | | |
| **UNIT III** | **Cascading Style Sheets** |  |
| Introduction, features, core syntax, style sheets and HTML, style rule cascading and inheritance, text properties, Box model, normal flow box layout, beyond the normal flow, lists, tables, cursor styles. | | |
| **UNIT IV** | **Client-side programming: JavaScript** |  |
| Basic syntax, variables and data types, statements, operators, literals, functions, objects, Arrays, built-in objects, JavaScript debuggers. | | |
| **UNIT V** | **Representing Web Data: XML** |  |
| Documents and vocabularies, Versions and declaration, Namespaces, Ajax, DOM and SAX parsers, transforming XML documents, XPath, XSLT, Displaying XML documents in Web browsers. | | |
| **Textbooks**: | | |
| 1. J.C. Jackson, Web technologies: A computer science perspective, Pearson. | | |
| **Reference Books:** | | |
| 1. Sebesta, Programming world wide web, Pearson. 2. Dietel and Nieto , Internet and World Wide Web – How to program, Pearson Education 3. Chris Bates , Web Programming, building internet applications, 2nd edition, WILEY, Dreamtech | | |
| **Online Learning Resources:** | | |
| <http://getbootstrap.com/>  <https://www.w3schools.com/whatis/>  <https://nptel.ac.in/courses/106105084> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

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| **(20A05704b) VR & AR FOR ENGINEERS**  **(Open Elective Course – III)** | | |
| **Course Objectives:** | | |
| * Introduce to the design of visualization tools * Demonstrate Virtual reality * Learn Virtual reality animation and 3D Art optimization * Understand the foundational principles describing how hardware, computer vision algorithms function * Explore the history of spatial computing and design interactions | | |
| **Course Outcomes:** | | |
| * Apply VR/MR/AR in various fields in industry * Design Data visualization tools * Design audio and video interaction paradigms * Apply technical and creative approaches to make successful applications and experiences. * Explain how the humans interact with computers | | |
| **UNIT I** |  |  |
| **Computer generated worlds:** what is augmented reality? what is virtual reality?  **Understanding virtual space:** defining visual space and content, defining position and orientation in three dimensions, navigation  **The Mechanics of Sight:** the visual path way, spatial vision, and Depth Cues.  **Component Technologies of Head mounted Displays:** Display fundamentals, related terminology and concepts, optical Architectures. | | |
| **UNIT II** |  |  |
| **Augmented Displays:** Binocular augmenting displays, Monocular augmenting displays.  **Fully immersive Displays:** PC-Console driven displays, smartphone based displays, CAVES and Walls, Hemispheres and Domes.  **The Mechanics of hearing:** Defining sound, the auditory pathway, sound cues and localization, the vestibular system.  **Audio displays:** Conventional audio | | |
| **UNIT III** |  |  |
| **The Mechanics of Feeling:** The Science of feeling, Anatomy and Composition of the skin.  **Tactile and force feedback Devices:**Haptic illusions, tactile feedback devices, Force feedback devices.  **Sensors for tracking Position, and orientation and motion:** introduction to sensor technologies, optical trackers, beacon trackers,electromagnetic trackers, inertial sensors, acoustic sensors.  **Devices to enable navigation and interaction:** 2D vs 3D interaction and navigation, the importance of a manual interface, hand and gesture tracking, whole body tracking, gaming and entertainment interfaces, navigating with your mind. | | |
| **UNIT IV** |  |  |
| **Gaming and Entertainment:**Virtual reality and the arts, gaming, immersive video/ cinematic virtual reality.  **Architecture and Construction:**Artificial spaces, architectural design: Manage group architectures, Construction management, real estate sales applications, architectural acoustics.  **Science and engineering:** Simulate and innovate, naval architecture and marine engineering, automotive engineering, aerospace engineering, nuclear engineering and manufacturing.  **Health and medicine**: advancing the field of medicine, training applications, treatment applications. | | |
| **UNIT** V |  |  |
| **Aerospace and Defence:** Flight simulation and training, mission planning and rehearsal, dismounted soldier situational awareness, advanced cockpit avionics, space operations.  **Education:** Tangible skills education, theory, knowledge acquisition and concept formation.  **Information control and big data visualization:** What is big data?, big data analytics and human vision.  **Telerobotics and Telepresence:** Defining Telerobotics and Telepresence, space applications and robonaut, undersea applications, Terrestrial and airborne applications. | | |
| **Textbooks**: | | |
| 1. Steve Aukstakalnis, “Practical Augmented Reality”, Pearson Education, 2017. | | |
| **Reference Books:** | | |
| 1. 1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, “Creating Augmented& Virtual Realities”, O’REILLY | | |
| **Online Learning Resources:** | | |
| 1. https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues 2. https://www.coursera.org/learn/ar | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

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|  | **(20A05704c) SOFTWARE ENGINEERING**  **(Open Elective Course – III)** |  |  |  |  |

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| **Course Objectives:** | | |
| * To learn the basic concepts of software engineering and life cycle models * To explore the issues in software requirements specification and enable to write SRS documents for software development problems * To elucidate the basic concepts of software design and enable to carry out procedural and object oriented design of software development problems * To understand the basic concepts of black box and white box software testing and enable to design test cases for unit, integration, and system testing * To reveal the basic concepts in software project management | | |
| **Course Outcomes (CO):** | | |
| After completion of the course, students will be able to   * Obtain basic software life cycle activity skills. * Design software requirements specifications for given problems. * Implement structure, object oriented analysis and design for given problems. * Design test cases for given problems. * Apply quality management concepts at the application level. | | |
| UNIT - I | **Basic concepts in software engineering and software project management** | Lecture 8Hrs |
| Basic concepts: abstraction versus decomposition, evolution of software engineering techniques, Software development life cycle (SDLC) models: Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, RAD model, Agile models, software project management: project planning, project estimation, COCOMO, Halstead’s Software Science, project scheduling, staffing, Organization and team structure, risk management, configuration management. | | |
| UNIT - II | **Requirements analysis and specification** | Lecture 8Hrs |
| The nature of software, The Unique nature of Webapps, Software Myths, Requirements gathering and analysis, software requirements specification, Traceability, Characteristics of a Good SRS Document, IEEE 830 guidelines, representing complex requirements using decision tables and decision trees, overview of formal system development techniques, axiomatic specification, algebraic specification. | | |
| UNIT - III | **Software Design** | Lecture 9Hrs |
| Good Software Design, Cohesion and coupling, Control Hierarchy: Layering, Control Abstraction, Depth and width, Fan-out, Fan-in, Software design approaches, object oriented vs. function oriented design. Overview of SA/SD methodology, structured analysis, Data flow diagram, Extending DFD technique to real life systems, Basic Object oriented concepts, UML Diagrams, Structured design, Detailed design, Design review, Characteristics of a good user interface, User Guidance and Online Help, Mode-based vs Mode-less Interface, Types of user interfaces, Component-based GUI development, User interface design methodology: GUI design methodology. | | |
| UNIT - IV | **Coding and Testing** | Lecture 9Hrs |
| Coding standards and guidelines, code review, software documentation, Testing, Black Box Testing, White Box Testing, debugging, integration testing, Program Analysis Tools, system testing, performance testing, regression testing, Testing Object Oriented Programs. | | |
| UNIT - V | **Software quality, reliability, and other issues** | Lecture 9Hrs |
| Software reliability, Statistical testing, Software quality and management, ISO 9000, SEI capability maturity model (CMM), Personal software process (PSP), Six sigma, Software quality metrics, CASE and its scope, CASE environment, CASE support in software life cycle, Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basic issues in any reuse program, Reuse approach, Reuse at organization level. | | |
| Textbooks: | | |
| 1. Rajib Mall, “Fundamentals of Software Engineering”, 5th Edition, PHI, 2018. 2. Pressman R, “Software Engineering- Practioner Approach”, McGraw Hill. | | |
| Reference Books: | | |
| 1. Somerville, “Software Engineering”, Pearson 2. 2. Richard Fairley, “Software Engineering Concepts”, Tata McGraw Hill. 3. JalotePankaj, “An integrated approach to Software Engineering”, Narosa | | |
| Online Learning Resources: | | |
| <https://nptel.ac.in/courses/106/105/106105182/>  <http://peterindia.net/SoftwareDevelopment.html> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A27704) HUMAN NUTRITION**

**(OPEN ELECTIVE-III)**

**Course Objectives:**

* To get knowledge on Concepts and content of nutrition source and metabolic functions.
* To know about Balanced diets for various groups; Diets and disorders, recommended dietary allowances
* To learn about Epidemiology of under nutrition and over nutrition.
* To understand Nutrition and immunity.

**Course Outcomes:**

* To study the Salient features of Concepts and content of nutrition, Malnutrition, Nutrition education
* Assessment of nutritional status, disorders Food fad and faddism.

**UNIT I**

Concepts and content of nutrition: Nutrition agencies; Nutrition of community; Nutritional policies and their implementation; Metabolic function of nutrients. Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings;

**UNIT II**

Water and energy balance: Water intake and losses; Basal metabolism- BMR; Body surface area and factors affecting BMR Formulation of diets: Classification of balanced diet; Balanced diets for various groups; Diets and disorders. Recommended dietary allowances (RDA); For various age group; According physiological status; Athletic and sports man; Geriatric persons

**UNIT III**

Malnutrition: Type of Malnutrition; Multi-factorial causes; Epidemiology of under nutrition and over nutrition; Nutrition and immunity.

**UNIT IV**

Nutrition education Assessment of nutritional status: Diet surveys; Anthropometry; Clinical examination; Biochemical assessment; Additional medical information

**UNIT V**

Blood constituents; Hormone types; Miscellaneous disorders Food fad and faddism. Potentially toxic substances in human food.

**Textbooks:**

1. Swaminathan M, Advanced Text Book on Food & Nutrition (Volume I and II) , The Bangalore Printing and Publishing Co.Ltd, Bangalore. 2006
2. Stewart Truswell, ABC of Nutrition (4th edition) , BMJ Publishing Group 2003, ISBN 0727916645.
3. Martin Eastwood, Principles of Human Nutrition , Blackwell Publishing, Boca Rotan

**Reference:**

1. Mike Lean and E. Combet ,Barasi’s Human Nutrition – A Health Perspective , Second Edition CRC Press, London
2. Introduction to Human Nutrition, Micheal J. G., Susan A.L. Aedin C. and Hester H.V, Wiley-Blackwell Publication, UK 2009 , ISBN 9781405168076
3. Bogert L.J., Goerge M.B, Doris H.C., Nutrition and Physical Fitness, W.B. Saunders Company, Toronto, Canada

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

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|  | **(20A54702) NUMERICAL METHODS FOR ENGINEERS**  **(OPEN ELECTIVE-III)** | |
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| **Course Objectives:** | | |
| This course aims at providing the student with the knowledge on various numerical methods for solving equations, interpolating the polynomials, evaluation of integral equations and solution of differential equations. | | |
| **Course Outcomes:** | | |
| * Apply numerical methods to solve algebraic and transcendental equations. * Understand fitting of several kinds of curves. * Derive interpolating polynomials using interpolation formulae. * Solve differential and integral equations numerically. | | |
| **UNIT I** | **Solution of Algebraic & Transcendental Equations** |  |
| Introduction-Bisection Method-Iterative method-Regula falsi method-Newton Raphson method. System of Algebraic equations: Gauss Jordan method-Gauss Siedal method. | | |
| **UNIT II** | **Curve Fitting** |  |
| Principle of Least squares- Fitting of curves- Fitting of linear, quadratic and exponential curves. | | |
| **UNIT III** | **Interpolation** |  |
| Finite differences-Newton’s forward and backward interpolation formulae – Lagrange’s formulae Gauss forward and backward formula, Stirling’s formula, Bessel’s formula | | |
| **UNIT IV** | **Numerical Integration** |  |
| Numerical Integration: Trapezoidal rule – Simpson’s 1/3 Rule – Simpson’s 3/8 Rule | | |
| **UNIT V Solution of Initial value problems to Ordinary differential equations** | | |
| Numerical solution of Ordinary Differential equations: Solution by Taylor’s series-Picard’s Method of successive Approximations-Modified Euler’s Method-Runge-Kutta Methods. | | |
| **Textbooks:** | | |
| 1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers. 2. Probability and Statistics for Engineers and Scientists, Ronald E. Walpole,PNIE. 3. Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley India | | |
| **Reference Books:** | | |
| 1. Higher Engineering Mathematics, by B.V.Ramana, Mc Graw Hill publishers. 2. Advanced Engineering Mathematics, by Alan Jeffrey, Elsevier. | | |
| **Online Learning Resources**: | | |
| <https://slideplayer.com/slide/8588078/> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A56702) SENSORS AND ACTUATORS FOR ENGINEERING APPLICATIONS**

**(OPEN ELECTIVE-III)**

**Course Objectives**:

* To provide exposure to various kinds of sensors and actuators and their engineering applications.
* To impart knowledge on the basic laws and phenomenon behind the working of sensors and actuators
* To enlighten the operating principles of various sensors and actuators
* To educate the fabrication of sensors
* To identify the required sensor and actuator for interdisciplinary application

**Course Outcomes:**

* To recognize the need of sensors and actuators
* To understand working principles of various sensors and actuators
* To identify different type of sensors and actuators used in real life applications
* To exploit basics in common methods for converting a physical parameter into an electrical quantity
* To make use of sensors and actuators for different applications

**UNIT I Introduction to Sensors and Actuators**

**Sensors**: Types of sensors: temperature, pressure, strain, active and passive sensors, General characteristics of sensors (Principles only), Materials used and their fabrication process: Deposition: Chemical Vapor Deposition, Pattern: photolithography and Etching: Dry and Wet Etching.

**Actuators:** Functional diagram of actuators, Types of actuators and their basic principle of working: Hydraulic, Pneumatic, Mechanical, Electrical, Magnetic, Electromagnetic, piezo-electric and piezo-resistive actuators, Simple applications of Actuators.

**UNIT II Temperature and Mechanical Sensors**

**Temperature Sensors**: Types of temperature sensors and their basic principle of working: Thermo-resistive sensors: Thermistors, Resistance temperature sensors, Silicon resistive sensors, Thermo-electric sensors: Thermocouples, PN junction temperature sensors

**Mechanical Sensors**: Types of Mechanical sensors and their basic principle of working: Force sensors: strain gauges, tactile sensors, Pressure sensors: semiconductor, piezoresistive, capacitive, VRP.

**UNIT III Optical and Acoustic Sensors**

**Optical Sensors**: Basic principle and working of: Photodiodes, Phototransistors and Photo-resistors based sensors, Photomultipliers, Infrared sensors: thermal, PIR, thermopiles

**Acoustic Sensors**: Principle and working of Ultrasonic sensors, Piezo-electric resonators, Microphones.

**UNIT IV Magnetic, Electromagnetic Sensors and Actuators**

Motors as actuators (linear, rotational, stepping motors), magnetic valves, inductive sensors (LVDT, RVDT, and Proximity), Hall Effect sensors, Magneto-resistive sensors, Magneto-strictive sensors and actuators, Voice coil actuators (speakers and speaker-like actuators).

**UNIT V Chemical and Radiation Sensors**

**Chemical Sensors**: Principle and working of Electro-chemical, Thermo-chemical, Gas, pH, Humidity and moisture sensors.

**Radiation Sensors**: Principle and working of Ionization detectors, Scintillation detectors, Geiger-Mueller counters, Semiconductor radiation detectors and Microwave sensors (resonant, reflection, transmission)

**Textbooks:**

1. Sensors and Actuators – Clarence W. de Silva, CRC Press, 2nd Edition, 2015

2. Sensors and Actuators, D.A.Hall and C.E.Millar, CRC Press, 1999

**Reference Books:**

1. Sensors and Transducers- D.Patranabhis, Prentice Hall of India (Pvt) Ltd. 2003

2. Measurement, Instrumentation, and Sensors Handbook-John G.Webster, CRC press 1999

3. Sensors – A Comprehensive Sensors- Henry Bolte, John Wiley.

4. Handbook of modern sensors, Springer, Stefan Johann Rupitsch.

5. Principles of Industrial Instrumentation By D. Patranabhis

**NPTEL courses links**

<https://onlinecourses.nptel.ac.in/noc21_ee32/preview>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A51702) CHEMISTRY OF NANOMATERIALS AND APPLICATIONS**

**(OPEN ELECTIVE-III)**

**Course Objectives:**

* To understand synthetic principles of Nanomaterials by various methods
* To characterize the synthetic nanomaterials by various instrumental methods
* To enumerate the applications of nanomaterials in engineering

**Course Outcomes:**

* Understand the state of art synthesis of nano materials
* Characterize nano materials using ion beam, scanning probe methodologies, position sensitive atom probe and spectroscopic ellipsometry.
* Analyze nanoscale structure in metals, polymers and ceramics
* Analyze structure-property relationship in coarser scale structures
* Understand structures of carbon nano tubes

**UNIT I**

Introduction: Scope of nanoscience and nanotecnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials.

Synthetic Methods**:** Bottom-Up approach**:** Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

**UNIT II**

Top-Down approach: Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling.

**UNIT III**

Techniques for characterization: Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

**UNIT IV**

Studies of Nano-structured Materials: Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, self- assembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

**UNIT V**

Engineering Applications of Nanomaterials

**Textbooks:**

1. NANO: The Essentials: T Pradeep, MaGraw-Hill, 2007.
2. Textbook of Nanoscience and nanotechnology: B S Murty, P Shankar, BaldevRai, BB Rath and James Murday, Univ. Press, 2012.

**References:**

1. Concepts of Nanochemistry; Ludovico Cademrtiri and Geoffrey A. Ozin& Geoffrey A. Ozin, Wiley-VCH, 2011.
2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications: Guozhong Cao, Imperial College Press, 2007.
3. Nanomaterials Chemistry, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

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| **(20A01706) HEALTH, SAFETY AND ENVIRONMENTAL MANAGEMENT PRACTICES**  **(Open Elective Course-IV)** | | |
| **Course Objectives:** | | |
| * To understand safety, health and environmental management. * To be familiar with hazard classification and assessment, hazard evaluation and hazard . control, environmental issues and management * To get exposed to accidents modeling, accident investigation and reporting, concepts of. HAZOP and PHA * To be familiar with safety measures in design and process operations. * To get exposed to risk assessment and management, principles and methods | | |
| **Course Outcomes :** | | |
| * To understand safety, health and environmental management. * To be familiar with hazard classification and assessment, hazard evaluation and hazard. * To get exposed to accidents modelling, accident investigation and reporting control, environmental issues and management * To get concepts of HAZOP and PHA. * To be familiar with safety measures in design and process operations. | | |
| **UNIT I** |  |  |
| Introduction to safety, health and environmental management - Basic terms and their definitions - Importance of safety - Safety assurance and assessment - Safety in design and operation - Organizing for safety. | | |
| **UNIT II** |  |  |
| Hazard classification and assessment - Hazard evaluation and hazard control.  Environmental issues and Management - Atmospheric pollution - Flaring and fugitive release - Water pollution - Environmental monitoring - Environmental management. | | |
| **UNIT III** |  |  |
| Accidents modelling - Release modelling - Fire and explosion modelling - Toxic release and dispersion Modelling | | |
| **UNIT IV** |  |  |
| Accident investigation and reporting - concepts of HAZOP and PHA.  Safety measures in design and process operations - Inserting, explosion, fire prevention, sprinkler systems. | | |
| **UNIT V** |  |  |
| Risk assessment and management - Risk picture - Definition and characteristics - Risk acceptance criteria - Quantified risk assessment - Hazard assessment - Fatality risk assessment - Risk management principles and methods. | | |
| **Textbooks:** | | |
| * + - 1. Process Safety Analysis, by Skelton. B, Gulf Publishing Company, Houston, 210pp., 1997.       2. Risk Management with Applications from Offshore Petroleum Industry, by TerjeAven and Jan Erik Vinnem, Springer, 200pp., 2007. | | |
| **Reference Books:** | | |
| 1. Introduction to Safety and Reliability of Structures, by Jorg Schneider 2. Structural Engineering Documents Vol. 5, International Association for Bridge and Structural Engineering (IABSE), 138pp., 1997. 3. Safety and Health for Engineers, by Roger L. Brauer, John Wiley and Sons Inc. pp. 645-663, 2006. 4. Health, Safety and Environmental Management in Offshore and Petroleum Engineering, Srinivasan Chandrasekaran, John Wiley and Sons, 2016. | | |
| **Online Learning Resources:** | | |
| <https://nptel.ac.in/courses/114106017> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

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| **(20A02705) RENEWABLE ENERGY SYSTEMS**  **(Open Elective Course – IV)** | | |
| **Course Objectives:** | | |
| * Understand various sources of Energy and the need of Renewable Energy Systems. * Understand the concepts of Solar Radiation, Wind energy and its applications. * Analyze solar thermal and solar PV systems * Understand the concept of geothermal energy and its applications, biomass energy, the concept of Ocean energy and fuel cells. | | |
| **Course Outcomes:** | | |
| * Understand various alternate sources of energy for different suitable application requirements * Understand the concepts of solar energy generation strategies and wind energy system * Analyze Solar and Wind energy systems * Understand the basics of Geothermal Energy Systems, various diversified energy scenarios of ocean, biomass and fuel cells | | |
| **UNIT I** | **SOLAR ENERGY** |  |
| Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. flat plate collectors, concentrating collectors, storage of solar energy-thermal storage. | | |
| **UNIT II** | **PV ENERGY SYSTEMS** |  |
| Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Electrical characteristics of silicon PV cells and modules, PV systems for remote power, Grid connected PV systems. | | |
| **UNIT III** | **WIND ENERGY** |  |
| Principle of wind energy conversion; Basic components of wind energy conversion systems; windmill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations. | | |
| **UNIT IV** | **GEOTHERMAL ENERGY** |  |
| Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India. | | |
| **UNIT V** | **MISCELLANEOUS ENERGY TECHNOLOGIES** |  |
| **Ocean Energ**y: Tidal Energy-Principle of working, performance and limitations. Wave Energy-Principle of working, performance and limitations.  **Bio mass Energy**: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration  **Fuel cell**: Principle of working of various types of fuel cells and their working, performance and limitations. | | |
| **Textbooks:** | | |
| 1. Stephen Peake, “Renewable Energy Power for a Sustainable Future”, Oxford International Edition, 2018. 2. G. D. Rai, “Non-Conventional Energy Sources”, 4th Edition, Khanna Publishers, 2000. | | |
| **Reference Books:** | | |
| 1. S. P. Sukhatme, “Solar Energy”,3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008. 2. B H Khan , “ Non-Conventional Energy Resources”, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011. 3. S. Hasan Saeed and D.K.Sharma,“Non-Conventional Energy Resources”,3rd Edition, S.K.Kataria& Sons, 2012. 4. G. N. Tiwari and M.K.Ghosal, “Renewable Energy Resource: Basic Principles and Applications”, Narosa Publishing House, 2004. | | |
| **Online Learning Resources:** | | |
| 1. <https://nptel.ac.in/courses/103103206>  2. <https://nptel.ac.in/courses/108108078> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A03705) INTRODUCTION TO COMPOSITE MATERIALS**

**(Open Elective-IV)**

**Course Objectives:**

* Introduce composite materials and their applications.
* Build proper background for stress analysis in the design of composite structures.
* Familiarize various properties of composite materials.
* Focus on biodegradable composites.

**Course Outcomes:**

* Identify the practical applications of composites. (L3)
* Identify the polymer matrix composites. (L3)
* Classify of bio- degradable composites. (L2)
* Outline the various types of ceramic matrix materials. (L2)

**UNIT I Introduction to composites**

Fundamentals of composites – Definition – classification– based on Matrix – based on structure – Advantages and applications of composites - Reinforcement – whiskers – glass fiber – carbon fiber - Aramid fiber – ceramic fiber – Properties and applications.

**UNIT II Polymer matrix composites**

Polymers - Polymer matrix materials – PMC processes - hand layup processes – spray up processes – resin transfer moulding – Pultrusion – Filament winding – Auto clave based methods - Injection moulding – sheet moulding compound – properties and applications of PMCs.

**UNIT III Metal matrix composites**

Metals - types of metal matrix composites – Metallic Matrices. Processing of MMC – Liquid state processes – solid state processes – In-situ processes. Properties and applications of MMCs.

**UNIT IV Ceramic matrix composites**

Ceramic matrix materials – properties – processing of CMCs –Sintering - Hot pressing – Infiltration – Lanxide process – Insitu chemical reaction techniques – solgel polymer pyrolsis –SHS - Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing). Properties and Applications of CCMs.

**UNIT V Advances & Applications of composites**

Advantages of carbon matrix – limitations of carbon matrix carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Properties and applications of Carbon-carbon composites. Composites for aerospace applications.Bio degradability, introduction of bio composites, classification, processing of bio composites, applications of bio composites - Mechanical, Biomedical, automobile Engineering.

**Textbooks:**

1. Chawla K.K, Composite materials, 2/e, Springer – Verlag, 1998.
2. Mathews F.L. and Rawlings R.D., Chapman and Hall, Composite Materials: Engineering and Science, 1/e, England, 1994.

**Reference Books:**

1. H K Shivanand, B V Babu Kiran, Composite Materials, ASIAN BOOKS, 2011.
2. A.B. Strong , Fundamentals of Composite Manufacturing, SME Publications, 1989.
3. S.C. Sharma, Composite materials, Narosa Publications, 2000.
4. Maureen Mitton, Hand Book of Bio plastics & Bio composites for Engineering applications, John Wiley publications, 2011.

**Online Learning Resources:**

* https://nptel.ac.in/courses/112104229
* https://nptel.ac.in/courses/112104168
* https://nptel.ac.in/courses/101104010
* https://nptel.ac.in/courses/105108124
* <https://nptel.ac.in/courses/112104221>

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A05705a) CYBER SECURITY**

**(Open Elective-III)**

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| **Course Objectives:** | | |
| The course is designed to provide awareness on different cyber crimes, cyber offenses, tools and methods used in cybercrime. | | |
| **Course Outcomes:** | | |
| * Classify the cybercrimes and understand theIndian ITA 2000 * Analyse the vulnerabilities in any computing system and find the solutions * Predict the security threats of the future * Investigate the protection mechanisms * Design security solutions for organizations | | |
| **UNIT I** | **Introduction to Cybercrime** |  |
| Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes. | | |
| **UNIT II** | **Cyber Offenses: How Criminals Plan Them** |  |
| Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber Cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing | | |
| **UNIT III** | **Cybercrime: Mobile and Wireless Devices** |  |
| Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops. | | |
| **UNIT IV** | **Tools and Methods Used in Cybercrime** |  |
| Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow. | | |
| **UNIT V** | **Cyber Security: Organizational Implications** |  |
| Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations. | | |
| **Textbooks:** | | |
| 1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA. | | |
| **Reference Books:** | | |
| 1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press. 2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J.David Irwin. CRC Press T&F Group | | |
| **Online Learning Resources:** | | |
| <http://nptel.ac.in/courses/106105031/40>  <http://nptel.ac.in/courses/106105031/39>  <http://nptel.ac.in/courses/106105031/38> | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

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| **(20A05705b) INTRODUCTION TO FULL STACK DEVELOPMENT**  **(Open Elective Course – IV)** | | |
| **Course Objectives:** | | |
| * To build foundation on HTML this will help developer to use HTML concepts for building responsive web application. * To Develop HTML based Single application for Browsers. * To Understand OOPs concepts and its applications by building competency in object –oriented Programming. * To implement frontend and backend scenarios using Web Sockets. * To become proficient in Bootstrap concepts. | | |
| **Course Outcomes:** | | |
| * Able to how to program a browser like using JavaScript, jQuery, Angular, or Vue. * Distinguishing trends in multi-device implementation. * Create webpages that function using external data. * Disambiguate the different structures that a no SQL database may represent. * Derive information from data and implement data into applications. | | |
| **UNIT I** |  |  |
| **e The Modern Web:** Rise of the Web, Mobile Web, The State of HTML, Applications vs Web Sites, Keeping Up.  **Planning Your Work: Identifying** Requirements, Defining the Work, Tracking the Work Continuous Improvement, Prioritization &Estimation, Managing Bugs, Continuous Delivery  **User Experience:** Information Architecture, Getting the User Experience Right, Polishing the User Experience, Implementing the User Experience. | | |
| **UNIT II** |  |  |
| **Designing Systems**: System Architectures, Identifying Concepts, Identifying User Interactions, Handling Commonalities, Working with Legacy and External Dependencies, Component Interactions, Applications vs. Modules, Cross-Functional Requirements, Caching, Designing for Failure, Designing Modules, Refactoring, Tools, Changing Your Architecture.  **Ethics:** Privacy, Cognitive Load, Energy Usage, Trust.  **Front End:** HTML, From Server to Browser, Styling, Components, Responsive Design, Progressive Enhancement to Progressively Enhance, or Not? Mobile First, Feature Detection, Progressive Enhancement of Style, When Not Using Progressive Enhancement, Search Engine Optimization, Build Tools. | | |
| **UNIT III** |  |  |
| **Testing:** Test-Driven Development, Test Pyramid, Behaviour-Driven Development, Three Amigos, Manual Testing, Visual Testing, Cross-Functional Testing,  **JavaScript:** Asynchronicity, JavaScript in the Browser, Offline-First Development, Document Object Model, Server-Side JavaScript, Table of Contents viii JavaScript Modules, Structuring Your JavaScript, JavaScript Types, Object-Oriented Programming, Functional Programming, Communicating Between Components, Connecting Components Together, Testing, Build Tools.  **Accessibility:** Accessible from the Start, Working with Assistive Technologies, Dealing with Interactive UI, Testing for Accessibility, Avoiding Common Mistakes. | | |
| **UNIT IV** |  |  |
| **APIs:** API Responsibilities, designing a REST API, Securing Your API, Event-Based APIs, Discovering APIs, Using APIs  **Storing Data**: [Types of Databases](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250033), [To SQL, or NoSQL?,](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250032)[Where to Store Your Data](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250031), [Accessing Data from Your App](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250030), Managing Your Data, Protecting Your Data.  **Security:** Trust, [Responding to Incidents](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250025), [The Golden Rule](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250024), [Threats](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250023), [Security Checklists](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250022), Passwords, Indirect Attacks. | | |
| **UNIT V** |  |  |
| **Deployment**: [Twelve Factor Apps](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250018), [Developer Machines](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250017), [Production Environments](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250016), [Moving Code into Production](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250015), [Configuring Your Box](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250014), [Infrastructure](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250013), [Immutable Infrastructure](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250012), [Continuous Delivery & Continuous Deployment](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250011).  **In Production:** [Fire Drills](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250009), [Run Books](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250008), [Monitoring](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250007), [Responding to Incidents](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250006)  **Constant Learning:** Collecting, [Experiments](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250003), [Analysing Results](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250002), [Hypothesis-Driven.](file:///E:\Finalized%20syllabus%20-%20Chenna%20Reddy\VII%20Sem%20Finalized%20Syllabus\IOT.docx#_TOC_250001) | | |
| **Textbook:** | | |
| 1. Chris Northwood, The full Stack Developer, Apress, 2018. | | |
| **Reference Books:** | | |
| 1. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker, Frank Zammetti. 2. Full Stack Web Development for Beginners, Riaz Ahmed. | | |
| **Online Learning Resources:** | | |
| 1. [Learn Full Stack Web Development with 40+ Projects and Exercises | Udemy](https://www.udemy.com/course/the-full-stack-web-development/?gclid=EAIaIQobChMI8bH41MCO-AIV85hmAh2U9AcGEAAYAyAAEgLOSvD_BwE&matchtype=e&utm_campaign=WebDevelopment_v.PROF_la.EN_cc.INDIA_ti.8322&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=_._ag_82381206618_._ad_533094291831_._kw_full+stack+web+development+course_._de_c_._dm__._pl__._ti_kwd-78030061962_._li_9040221_._pd__._) | | |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A27705) WASTE AND EFFLUENT MANAGEMENT**

**(OPEN ELECTIVE-IV)**

**Course Objectives:**

* To understand the wastewater treatment process.
* To gain knowledge on waste disposal in various ways.
* To know about advances in wastewater treatment.

**Course Outcomes:**

* Acquires knowledge on technologies used for chemical and biological methods of waste water and effluent treatment

**UNIT I**

Wastewater Treatment an Overview: Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents. Process Analysis and Selection: Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non ideal flow in Reactors – Process Selection

**UNIT II**

Waste disposal methods – Physical, Chemical & Biological; Economical aspects of waste treatment and disposal. Treatment methods of solid wastes: Biological composting, drying and incineration; Design of Solid Waste Management System: Landfill Digester, Vermicomposting Pit.

**UNIT III**

Introduction: Classification and characterization of food industrial wastes from Fruit and Vegetable processing industry, Beverage industry; Fish, Meat & Poultry industry, Sugar industry and Dairy industry.

Chemical Unit Processes: Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage

**UNIT IV**

Biological Treatment: Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

**UNIT V**

Advanced Wastewater Treatment: Technologies used in advanced treatment – Classification of technologies. Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration- Absorption – Ion Exchange – Advanced oxidation process.

**Textbooks:**

1. Herzka A & Booth RG; “Food Industry Wastes: Disposal and Recovery”; Applied Science Pub Ltd. 1981,
2. Fair GM, Geyer JC & Okun DA; “Water & Wastewater Engineering”; John Wiley & Sons, Inc. 1986,

**References:**

1. GE; “Symposium: Processing Agricultural & Municipal Wastes”; AVI. 1973,
2. Inglett Green JH & Kramer A; “Food Processing Waste Management”; AVI. 1979,
3. Rittmann BE & McCarty PL; “Environmental Biotechnology: Principles and Applications”; Mc-Grow-Hill International editions2001,.
4. Bhattacharyya B C & Banerjee R; “Environmental Biotechnology”; Oxford University Press.
5. Bartlett RE; “ Wastewater Treatment; Applied Science” Pub Ltd.
6. G. Tchobanoglous, FI Biston, “Waste water Engineering Treatment and Reuse”: Mc Graw Hill, 2002.
7. “Industrial Waste Water Management Treatment and Disposal by Waste Water” 3rd Edition Mc Graw Hill 2008

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

|  |
| --- |
| **(20A54703) NUMBER THEORY AND ITS APPLICATIONS**  **(OPEN ELECTIVE-IV)** |
| **Course Objectives:** |
| This course enables the students to learn the concepts of number theory and its applications to information security. |
| **Course Outcomes:** |
| * Understand number theory and its properties. * Understand principles on congruences * Develop the knowledge to apply various applications * Develop various encryption methods and its applications. |
| **UNIT I Integers, Greatest common divisors and prime Factorization** |
| The well-ordering property-Divisibility-Representation of integers-Computer operations with integers-Prime numbers-Greatest common divisors-The Euclidean algorithm -The fundamental theorem of arithmetic-Factorization of integers and the Fermat numbers-Linear Diophantine equations |
| **UNIT II Congruences** |
| Introduction to congruences -Linear congruences-The Chinese remainder theorem-Systems of linear congruences |
| **UNIT III Applications of Congruences** |
| Divisibility tests-The perpetual calendar-Round-robin tournaments-Computer file storage and hashing functions. Wilson's theorem and Fermat's little theorem- Pseudo primes- Euler's theorem- Euler's p hi-function- The sum and number of divisors- Perfect numbers and Mersenne primes. |
| **UNIT IV Finite fields & Primality, factoring** |
| Finite fields- quadratic residues and reciprocity-Pseudo primes-rho method-fermat factorization and factor bases. |
| **UNIT V Cryptology** |
| Basic terminology-complexity theorem-Character ciphers-Block ciphers-Exponentiation ciphers- Public-key cryptography-Discrete logarithm-Knapsack ciphers- RSA algorithm-Some applications to computer science. |
| **Textbooks:** |
| 1. Elementary number theory and its applications, Kenneth H Rosen, AT & T Information systems & Bell laboratories. 2. A course in Number theory & Cryptography, Neal Koblitz, Springer. |
| **Reference Books:** |
| 1. An Introduction To The Theory Of Numbers, [Herbert S. Zuckerman](https://www.amazon.in/Herbert-S-Zuckerman/e/B00288HHJ4/ref=dp_byline_cont_book_1), [Hugh L. Montgomery](https://www.amazon.in/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Hugh+L.+Montgomery&search-alias=stripbooks), [Ivan Niven](https://www.amazon.in/s/ref=dp_byline_sr_book_3?ie=UTF8&field-author=Ivan+Niven&search-alias=stripbooks), wiley publishers 2. Introduction to Analytic number theory-Tom M Apostol, springer 3. Elementary number theory, VK Krishnan, Universities press |
| Online Learning Resources: |
| <https://www.slideshare.net/ItishreeDash3/a-study-on-number-theory-and-its-applications> |

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A56703) SMART MATERIALS AND DEVICES**

**(OPEN ELECTIVE-IV)**

**Course Objectives**:

* To provide exposure to smart materials and their engineering applications.
* To impart knowledge on the basics and phenomenon behind the working of smart materials
* To enlighten the properties exhibited by smart materials
* To educate various techniques used to synthesize and characterize smart materials
* To identify the required smart material for distinct applications/devices

**Course Outcomes:**

* to recognize the need of smart materials
* to understand the working principles of smart materials
* to know different techniques used to synthesize and characterize smart materials
* to exploit the properties of smart materials
* to make use of smart materials for different applications

**UNIT I**

**Introduction**: Historical account of the discovery and development of smart materials, Two phases: Austenite and Martensite, Temperature induced phase changes, Shape memory effect, Pseudoelasticity, One-way shape memory effect, Two-way shape memory effect.

**UNIT II: Properties of Smart Materials**: Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials

**UNIT III: Synthesis of smart materials**: Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Co-precipitaiton. Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Sol-gel, spray pyrolysis.

**UNIT IV: Characterization techniques**: X-ray diffraction, Raman spectroscopy (RS), Fourier-transform infrared reflection (FTIR), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy, Atomic force microscopy (AFM) and Differential Scanning Calorimetry (DSC).

**UNIT V: Materials and Devices:** Characteristics of shape memory alloys, Magnetostrictive, Optoelectronic, Piezoelectric, Metamaterials, Electro-rheological and Magneto-rheological materials and Composite materials.

Devices based on smart materials: Sensors & Actuators, MEMS and intelligent devices, Future scope of the smart materials.

**Textbooks:**

1. Encyclopaedia of Smart Materials- Mel Schwartz, John Wiley & Sons, Inc.2002
2. Smart Materials and Structures - M. V. Gandhi and B.S. Thompson, Champman and Hall, 1992

**References:**

1. Smart Materials and Technologies- M. Addington and D. L. Schodek, , Elsevier, 2005.
2. Characterization and Application of smart Materials -R. Rai, Synthesis, , Nova Science, 2011.
3. Electroceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, 2ndEdn., John Wiley & Sons, 2003.
4. Piezoelectric Sensorics: Force, Strain, Pressure, Acceleration and Acoustic 1. Emission Sensors, Materials and Amplifiers, G. Gautschi, Springer, 2002.
5. Optical Metamaterials: Fundamentals and Applications -W. Cai and V. Shalaev, springer,2010.
6. Smart Materials and Structures - P. L Reece, New Research, Nova Science, 2007

**NPTEL courses links**

<https://nptel.ac.in/courses/112/104/112104173/>

<https://nptel.ac.in/courses/112/104/112104251/>

https://nptel.ac.in/content/storage2/courses/112104173/Mod\_1\_smart\_mat\_lec

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech IV-I Sem L T P C**

**3 0 0 3**

**(20A51703) GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT (OPEN ELECTIVE-IV)**

**Course Objectives:**

* Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry and the redesign of chemicals, industrial processes and products.
* Understand the use of alternatives assessments that combine chemical, environmental health, regulatory, and business considerations to develop safer products.

**Course Outcomes:**

* Recognize and acquire green chemistry concepts and apply these ideas to develop respect for the inter connectedness of our world and an ethic of environmental care and sustainability.

**UNIT I: PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY**

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation, Polymer recycling.

**UNIT II: CATALYSIS AND GREEN CHEMISTRY**

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous catalysis: Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Heterogenising the Homogenous catalysts, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Bio-catalysis and photo-catalysis with examples.

**UNIT III: ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS**

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water-based coatings, Ionic liquids as catalyst and solvent

**UNIT IV: EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES**

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable feedstocks: Chemicals from Renewable Feedstocks: Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies: The Syngas Economy, The Biorefinery, Design for energy efficiency: Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions, Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry: Sonochemistry and Green Chemistry, Electrochemical Synthesis: Examples of Electrochemical Synthesis. Industrial applications of alternative environmentally benign catalytic systems for carrying out the important reactions such as selective oxidation, reduction and C-C bond formations (specific reactions).

**UNIT V: GREEN PROCESSES FOR GREEN NANOSCIENCE**

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

**Textbooks:**

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford University Press, USA

**References:**

# Green Chemistry for Environmental Sustainability, First Edition, Sanjay K. Sharma and AckmezMudhoo, CRC Press, 2010.

# Edited by AlvisePerosa and Maurizio Selva , Hand Book of Green chemistry Volume 8:Green Nanoscience, wiley-VCH, 2013.

**HONOURS**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech (ECE) L T P C**

**3 1 0 4 (20A04H01) ADAPTIVE SIGNAL PROCESSING**

**Course Objectives:**

This course focuses on adaptive algorithms and solutions for processing signals in amanner that is responsive to a changing environment.

**Course Outcomes:**

* Design and apply optimal minimum mean square estimators and in particular line are estimators.
* Design, implement and apply Wiener Filters (FIR, non-casual, causal) and evaluate their performance.
* Develop systems on recursive, model-based estimation methods taking the advantage of the statistical properties of the received signals.
* Analyze the performance of adaptive filters and application to practical problems such as beam forming and echo cancellation signal.

**UNIT 1**

Introduction to Adaptive Systems Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description,

Weight Vectors, Desired Response Performance function - Gradient & Mean Square Error.

**UNIT 2**

Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonally - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.

**UNIT 3**

Steepest Descent Algorithms: Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of

convergence - Learning Curves Gradient Search by Newton’s Method, Method of Steepest Descent, Comparison of Learning Curves.

**UNIT 4**

LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability &Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms -Convergence of LMS algorithm. Applications: Adaptive BFSK, BPSK, ASK demodulators and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform.

**UNIT 5**

State Estimators: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

**Textbooks:**

1. Adaptive Signal Processing - Bernard Widrow, Samuel D.Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4 ed., 2002,PE Asia.

**References:**

1. Digital Signal Processing: A Practitioner's Approach, Kaluri V. Rangarao, Ranjan K.Mallik ISBN: 978-0-470-01769-2, 210 pages, November 2006, John Weley (UK)
2. Optimum signal processing: An introduction - Sophocles.J.Orfamadis, 2 ed., 1988,McGraw-Hill, Newyork
3. Adaptive signal processing-Theory and Applications, S.Thomas Alexander, 1986,Springer –Verlag.

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**B.Tech. (ECE) L T P C**

**3 1 0 4**

**(20A04H02) SOFTWARE DEFINED RADIO**

**Course Objectives:**

* Learn the design of the wireless networks based on the cognitive radio
* Understand the concepts of wireless networks and next generation networks

**Course Outcomes:**

* Describe basics of the software defined radios
* Understand the architectures of SDR
* Design the wireless networks based on the cognitive radios.
* Explain the concepts behind the wireless networks and next generation networks

**UNIT I** Introduction to Software Defined Radio

Introduction to Software Defined Radio: Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

**UNIT II** SDR Architecture

SDR Architecture: Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

**UNIT III** Introduction to Cognitive Radios

Introduction to Cognitive Radios: Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

**UNIT IV**  Cognitive Radio Architecture

Cognitive Radio Architecture: Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

**UNIT V** Next Generation Wireless Networks

Next Generation Wireless Networks: The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

**Textbooks:**

1. Joseph MitolaIII, Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering, John Wiley & Sons Ltd., 2000.
2. Thomas W. Rondeau, Charles W. Bostain, Artificial Intelligence in Wireless communication, ARTECH house, 2009.

**References:**

1. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.
2. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey” Elsevier Computer Networks, May 2006.
3. Hasari Celebi, Huseyin Arslan, Enabling Location and Environment Awareness in Cognitive Radios, Elsevier Computer Communications, Jan 2008.
4. Huseyin Arslan, Cognitive Radio, SDR and Adaptive System, Springer, 2009

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**B.Tech. (ECE) L T P C**

**3 1 0 4**

**(20A04H03) MICRO ELECTROMECHANICAL SYSTEMS**

**Course Objectives:**

* To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
* To educate on the rudiments of micro fabrication techniques.
* To introduce various sensors and actuators
* To introduce different materials used for MEMS.
* To educate on the applications of MEMS to disciplines beyond electrical and mechanical engineering.

**Course Outcomes:**

* Explain electrical and mechanical principles of MEMS
* Describe working of electrostatic, thermal and magnetic sensors and actuators
* Demonstrate piezoelectric effect and its applications
* Categorize micromachining processes
* Describe operation of polymer and optical MEMS

**UNIT I INTRODUCTION**

Intrinsic characteristics of MEMS – Energy domains and Transducers- Sensors and Actuators – Introduction to Micro Fabrication – Silicon based MEMS processes – new materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor Devices – Stress and Strain Analysis – Flexural Beam Bending- Torsional Deflection.

**UNIT II SENSORS AND ACTUATORS-I**

Electrostatic Sensors – Parallel Plate Capacitors – Applications – Interdigitated Finger Capacitor – Comb Drive Devices – Micro Grippers – Micro Motors – Thermal Sensing and Actuation – Thermal Expansion – Thermal Couples – Thermal Resistors – Thermal Bimorph – Applications – Magnetic Actuators – Micro magnetic Components – Case Studies of MEMS in Magnetic Actuators- Actuation using Shape Memory Alloys.

**UNIT III SENSORS AND ACTUATORS-II**

Piezoresistive Sensors – Piezoresistive Sensor Materials – Stress Analysis of Mechanical Elements – Applications to Inertia, Pressure, Tactile and Flow Sensors – Piezoelectric Sensors and Actuators – Piezoelectric Effects – Piezoelectric Materials – Applications to Inertia, Acoustic, Tactile and Flow Sensors.

**UNIT IV MICROMACHINING**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case Studies –Basic Surface Micro Machining Processes – Structural and Sacrificial Materials – Acceleration of Sacrificial Etch – Striction and Antistriction Methods – LIGA Process – Assembly of 3D MEMS –Foundry Process.

**UNIT VPOLYMER AND OPTICAL MEMS**

Polymers in MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application to Acceleration, Pressure, Flow and Tactile Sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

**Textbooks:**

1. Chang Liu, ‘Foundations of MEMS’, Pearson Education Inc., 2012.
2. Stephen D Senturia, ‘Microsystem Design’, Springer Publication, 2000.
3. Tai Ran Hsu, “MEMS & Micro Systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

**References:**

1. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
2. Mohamed Gad-El-Hak, Editor, “ The MEMS Handbook”, CRC Press Baco Raton, 2001.

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**B.Tech. (ECE) L T P C**

**3 1 0 4**

**(20A04H04) LOW POWER VLSI DESIGN**

**Course Objectives:**

This course addresses a profound analysis on the development of the CMOS & Bi-CMOS digital circuits for a low voltage low power environment

**Course Outcomes**:

* Understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
* Implement Low power design approaches for system level and circuit level measures.
* Design low power adders, multipliers and memories for efficient design of systems.

**UNIT I**

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation – Static and Dynamic Power Dissipation, Short Circuit Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

**UNIT II**

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

**UNIT III**

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder’s Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

**UNIT IV**

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

**UNIT V**

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trendand Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

**Textbooks:**

1. CMOS Digital Integrated Circuits – Analysis and Design – Sung-Mo Kang, Yusuf Leblebici,TMH, 2011.
2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH ProfessionalEngineering.

**References:**

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC

Press, 2011.

1. Low Power CMOS Design – AnanthaChandrakasan, IEEE Press/Wiley International, 1998.
2. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley &amp; Sons,2000.

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**B.Tech. (ECE) L T P C**

**3 1 0 4**

**(20A04H05) WIRELESS COMMUNICATIONS**

**Course Objectives:**

* To impart knowledge on different wireless standards and their technical specifications.
* To teach different propagation models.
* To present concepts of 3G/4G Wireless Communication systems to solve the relevant problems.
* To dissimilate different Wireless Technologies such as CDMA, MIMO, and OFDM through performance metrics to find the merits and demerits.

**Course Outcomes**:

* List Wireless standards and their technical specifications
* Compare different propagation models
* Apply concepts of 3G/4G wireless communication systems to solve problems
* Analyze performance of various 3G/4G wireless communication systems under AWGN and small-scale Fading channel conditions
* Compare different wireless technologies through performance metrics

**UNIT I Wireless Standards & Basics of Digital Communication Systems**

Introduction to 3G/4G Wireless Communications - Introduction, 2G, 3G, and 4G Wireless standards, Overview of Cellular Service Progression, Problem Solving.

Basics of Digital Communication Systems - Gaussian RV, BER performance of Communication Systems in an AWGN channel - BER for BPSK, SER and BER for QPSK, BER for M-ary PAM, BER for M-ary QAM, BER for M-ary PSK, Binary Signal Detection Problem, Problem Solving.

**UNIT II Principles of Wireless Communications**

Wireless Communication Environment, Modeling of Wireless Systems, System model for Narrow band Signals, Rayleigh Fading Channel - Baseband model of a Wireless System, BER Performance of Wireless Systems - SNR, and derivation of BER expression under Rayleigh Channel Conditions, Channel Estimation in Wireless Systems, Diversity in Wireless Systems, Multiple Receive Antenna System Model, Symbol Detection in Multiple Antenna Systems, BER for Multi-Antenna Wireless Systems - BER derivation, Channel Estimation for Multi-Antenna Systems.

**UNIT III Basics of Channel Modeling**

Maximum Delay Spread, RMS delay Spread, Power delay profile, Coherence Bandwidth, Doppler Spread, Impact of Doppler spread on Wireless Channel, Coherence Time, Clarke's Model, Simulation Procedure for flat fading and Frequency Selective Fading Channels, Jakes Model for Wireless Channel Correlation, Implications of Coherence Time, Problem Solving.

**UNIT IV**

**Code Division Multiple Access (CDMA)** - Introduction to CDMA, Basic Mechanism, Fundamentals of CDMA Codes, PN sequences and their properties, Multi-User CDMA, Advantages, Near - Far Problem and Power Control, Performance of CDMA Uplink and Downlink Scenarios with Multi users, Asynchronous CDMA, Problem Solving.

**Multiple Input Multiple Output (MIMO) Technology:** Introduction to MIMO, System Model, MIMO zero-forcing (ZF) Receiver - Properties, Principle of orthogonality, Interpretation of ZF Receiver, MIMO MMSE Receiver - Robustness of MMSE to noise amplification, SNR calculations, Properties of MMSE Receiver, Singular Value Decomposition (SVD) of the MIMO channel, MIMO Capacity, Alamouti and Space Time Codes, Nonlinear MIMO Receiver, MIMO Beam Forming, Problem Solving.

**UNIT V**

**Orthogonal Frequency -Division Multiplexing (OFDM)**: Motivation and Multicarrier Basics - Multicarrier Transmission, Cyclic Prefix in OFDM, Impact of Cyclic Prefix on Data Rate, Example, BER for OFDM system, MIMO-OFDM, Drawbacks in OFDM - Peak to Average Power Ratio (PAPR), Effect of Frequency offset in OFDM, SC-FDMA - Receiver, and Subcarrier Mapping in SC-FDMA.

**Wireless System Planning:** Free Space Propagation Model, Ground - Reflection Scenario, Okumura Model, Hata Model, Log normal Shadowing, Receiver Noise Computation, Link Budget Analysis.

**Textbooks:**

1. Aditya K Jagannatham, "Principles of Modern Communication Systems - Theory and Practice," McGraw Hill Education, 2016.
2. T. S. Rappaport, "Wireless Communications - Principles and Practice," Second Edition, Pearson, 2010.

**References:**

1. John Proakis, "Digital Communications," McGraw Hill, 2003
2. Modern Digital and Analog Communication Systems, B. P. Lathi. Zhi Ding, International Fourth Edition, 2010.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**B.Tech. (ECE) L T P C**

**3 1 0 4**

**(20A04H06) SPEECH PROCESSING**

**Course Objectives:**

* To impart knowledge on anatomy and physiology of Speech Production system and perception model.
* To describe speech parameters in frequency domain for various applications
* To introduce concept of homomorphic system and its use in extracting the vocal tract information from speech

**Course Outcomes:**

* Formulate vocal tract model based on the speech production mechanism
* Solve features of speech in Time Domain
* Describe feature extraction techniques in frequency domain
* Use LPC coefficients for Pitch and Formant detection
* Analyze the given speech using homomorphic system

**UNIT I**

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The process of Speech Production, The Acoustic Theory of Speech Production – Uniform lossless tube model, effect of losses in vocal tract and radiation at lips, Digital models for speech signals.

**UNIT II**

Time Domain Methods for Speech Processing: Time domain parameters of speech, methods for extracting the parameters: Zero crossings, Auto-correlation function, pitch estimation.

**UNIT III**

Frequency Domain Methods for Speech Processing: Short time Fourier analysis, Filter bank analysis, Spectrographic analysis, Formant extraction, Pitch extraction.

**UNIT IV**

Linear predictive Coding (LPC) for Speech: Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains, Method of Solution of the LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

**UNIT V**

Homomorphic Speech Processing: Introduction Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, pitch Detection and Formant Estimation; Applications of speech processing – Speech Enhancement, Speech recognition, Speech synthesis and Speaker Verification.

**Textbooks:**

1. L.R. Rabiner and S. W. Schafer, Digital Processing of Speech Signals, Pearson Education.
2. Douglas O’ Shaughnessy, Speech Communications: Human &Machine, 2nd Ed., Wiley-IEEE Press.

**References:**

1. Thomas F. Quatieri, Discrete Time Speech Signal Processing: Principles and Practice, 1st Ed., Pearson Education.
2. Ben Gold & Nelson Morgan, Speech and Audio Signal Processing: Processing and Perception of Speech and Music ,1st Ed., Wiley.