**KURUKSHETRA UNIVERSITY KURUKSHETRA**

**Bachelor of Technology (Electrical & Electronics Engineering) (Credit Based)**

**Scheme of Studies/Examination**

**Semester V (w.e.f. session 2020-21 onwards)**

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| **S.**  **No.** | **Course No.** | **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | | | | **Duration of Exam (Hrs.)** |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | **\*EE-301A** | **Power System – I** | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2 | **\*EE-305A** | **Control Systems** | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 3 | EENP\*\* | Program Elective - I | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | **\*EE-309A** | **Microprocessors** | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | EENO\*\* | Open Elective - I | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 6 | **\*EE-313A** | **Power System Lab - I** | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 7 | **\*EE-315A** | **Microprocessors Lab** | 0:0:2 | 2 | 1 | 0 | 40 | 60 | 100 | 3 |
| 8 | **\*EE-317A** | **Control Systems Lab** | 0:0:2 | 2 | 1 | 0 | 40 | 60 | 100 | 3 |
| 9 | \*\*\*EEN-319A | Industrial Training-II | 2:0:0 | 2 | - | - | \*100 | - | \*100 | 3 |
| 10 | \*\*\*\*MC-903A | Essence of Indian Traditional Knowledge | 3:0:0 | 3 | - | 100 | - | 0 | 100 | 3 |
|  |  | **Total** |  | **28** | **20** | **375** | **245** | **180** | **800** |  |

**\*\*The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

\*\*\*EEN-319A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

\*\*\*\*MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

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| **Course No.** | **Program Elective I** |  | **Course No.** | **Open Elective I** |
| \*EEP-329A | Digital Signal Processing | \*EEO-325A | Computer Networks |
| \*EEP-307A | Electrical Machine Design | EENO-303A | Big Data Analysis |
| EENP-305A | Electromagnetic Field Theory | EENO-305A | VLSI Circuits |
| \*EEP-318A | Computer Architecture | EENO-307A | Power Plant Engineering |

\* Subjects Common with Vth Semester. B.Tech. [Electrical Engg.] Scheme, K.U.K.

## KURUKSHETRA UNIVERSITY KURUKSHETRA

## Bachelor of Technology (Electrical & Electronics Engineering) (Credit Based)

**Scheme of Studies/Examination**

**Semester VI (w.e.f. session 2020-21 onwards)**

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| **S. No.** | **Course No.** | **Subject** | **L:T:P** | **Hours/ Week** | **Credits** | **Examination Schedule (Marks)** | | | | **Duration of Exam (Hrs.)** |
| **Major Test** | **Minor Test** | **Practical** | **Total** |
| 1 | **\*EE-302A** | **Power System – II** | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2 | HM-901A | Organizational Behavior | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | EENP\*\* | Program Elective - II | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | EENO\*\* | Open Elective - II | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | **\*EE-310A** | **Electrical Measurements and Measuring Instrumentation** | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 6 | **\*EE-312A** | **Power System Lab - II** | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 7 | **\*EE-314A** | **Measurements and Instrumentation Lab** | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 8 | **\*EE-316A** | Electronic Design Lab | 0:0:4 | 4 | 2 | - | 40 | 60 | 100 | 3 |
|  |  | **Total** |  | **24** | **20** | **375** | **245** | **180** | **800** |  |

#### \*\* The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section. Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

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| **Course No.** | **Program Elective II** |  | **Course No.** | **Open Elective II** |
| \*EEP-304A | Power System Protection | \*EEO-320A | Electrical Materials |
| \*EEP-306A | Electrical Energy Conservation and Auditing | \*EEO-322A | Strength of Materials |
| \*EEP-308A | Biomedical Signal & Image Processing | EENO-306A | Internet of Things |

\* Subjects Common with VIth Semester. B.Tech. [Electrical Engg.] Scheme, K.U.K.

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| **EE-301A** | **Power System -I** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **1** | **0** | **4** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To enable students to analyses power system networks, network parameters, modeling of transmission line | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Understand the concepts of power systems. | | | | | | |
| **CO2** | Understand the various power system components | | | | | | |
| **CO3** | Understand various compensation techniques | | | | | | |
| **CO4** | Determine methods of generation of overvoltage | | | | | | |

**UNIT- I**

**Evolution of Power Systems**: Typical power system, Modern trends in power system transmission. Underground and overhead system, Effects of increase in Voltage on transmission line efficiency, Radial and ring main system. Different types of distributors; Relative copper consumption in various systems. Conductor size and Kelvin’s Law

**UNIT- II**

**Transmission line modelling & compensation**: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. Travelling-wave Equations

**UNIT- III**

**Overhead Transmission Lines:** Overhead Transmission Lines: Electrical and Magnetic Fields around conductors, Corona loss, Bundled conductors Parameters of lines. Capacitance and Inductance calculations for simple configurations. Skin effects, Proximity effect

**UNIT IV**

**Generation of Over-voltages:** Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Steady state, transient and sub-transient equivalent circuits.

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over- voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges

**Text Books/References**:

1. Power System analysis and Stability by S.S. Vadhera

2. Electrical Power System by C.L. Wadhwa

3. Electrical Power System by Ashfaq Hussain

4. Elements of Power System Analysis by W.D. Stevenson

5. Electric Power System by B.M. Weddy

6. The transmission and Distribution of Electric energy by H. Cotton

7. Modern Power System Analysis by I.J. Nagrath and D.P. Kothari

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| **EE-305A** | **Control Systems** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **1** | **0** | **4** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To enable students to analyses basic of control system, time and frequency domain analysis of various system | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Understand the Mathematical models of physical systems | | | | | | |
| **CO2** | Understand the concept of stability and its assessment for linear-time invariant systems | | | | | | |
| **CO3** | Determine the state space variables and state equations | | | | | | |
| **CO4** | Find the time and frequency response of system | | | | | | |

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**UNIT I**

**Control Systems: Basics & Components**: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

**UNIT II**

**Time–Domain Analysis:** Standard test signals, Time response of first and second order systems for standard test inputs, Application of initial and final value theorem, Design specifications for second-order systems based on the time-response, Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique, Construction of Root-loci.

**UNIT III**

**Frequency Domain Analysis and Stability:** Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

**UNIT IV**

**State Space & Compensation Techniques:** Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Text/References:

1. Control System Engg. By Nagrath and Gopal.

2. Control System Engg. By K.Ogata.

3. Liner Control System by R.S. Chauhan, (Umesh Publications)

4. Feedback control system Analysis and Synthesis by D’Azzo and Houpias.

5. Control System by B.C. Kuo.

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| **EEP-329A** | **Digital Signal Processing** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of discrete time signals and digital filters . | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Represent signals mathematically in continuous and discrete-time, and in the frequency domain. | | | | | | |
| **CO2** | Analyse discrete-time systems using z-transform | | | | | | |
| **CO3** | Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. | | | | | | |
| **CO4** | Design digital filters for various applications | | | | | | |

**UNIT-1**

**Discrete-time signals and systems**

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

**UNIT-2**

**Z-transform**

Z Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

**UNIT-3**

**Discrete Fourier Transform**

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval’s Identity, Implementation of Discrete Time Systems.

**UNIT-4**

**Design of Digital filters**

Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band- stop and High-pass filters.

**Text/Reference Books:**

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.

2. A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 1989.

3. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And

Applications”, Prentice Hall, 1997.

4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.

5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.

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| **EEP-307A** | **Electrical Machine Design** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of designing of various electrical machine | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Understand the construction and performance characteristics of electrical machines. | | | | | | |
| **CO2** | Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines | | | | | | |
| **CO3** | Understand the principles of electrical machine design and carry out a basic design of an ac machine | | | | | | |
| **CO4** | Use software tools to do design calculations | | | | | | |

**UNIT 1**

**Introduction**

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

**UNIT 2**

**Transformers**

Sizing of a transformer, main dimensions, output equation for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

**UNIT 3**

**Induction Motors**

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current

**UNIT4**

**DC MACHINES:** Output equation, choice of specific loadings, choice of poles and speed, Design of core length, armature diameter, depth of armature core, air gap length, cross section of armature conductors, armature slots.

**COMPUTER AIDED DESIGN**: Computerization of design procedures, development of computer programs & performance predictions, optimization techniques & their application to design problems.

**Text / References:**

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.

2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.

3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and

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| **EENP-305A** | **Electromagnetic Field Theory** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To familiarize the students with the concepts of Electric and Magnetic Fields and make them understand the phenomenon of propagation of electromagnetic waves. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Basics of electrostatics including dielectric properties will be covered. | | | | | | |
| **CO2** | Basics of Magneto-statics and Maxwell’s equations will be covered. | | | | | | |
| **CO3** | Fundamentals of uniform plane waves and their propagation in different mediums will be covered. | | | | | | |
| **CO4** | Fundamentals of Transmission Lines and different modes of wave propagation in waveguides will be covered. | | | | | | |

**UNIT 1**

**Electric Field and Current:** Introduction to vectors: Addition, Subtraction, Multiplication and Differentiation. Coordinate Systems: Rectangular, Cylindrical & Spherical. Coulomb’s law. Electric Field Intensity, Electric Potential, Field of a Line Charge, Field of a Sheet of Charge, Electric Flux Density, Electric Dipole, Current Density, Continuity of Current, Gauss’s Law and Applications, Electric Field behaviour in Dielectrics, Boundary Conditions at Interface between Two Dielectrics, Method of Images, Capacitance of Two Wire Line, Poisson’s and Laplace’s Equations, Uniqueness Theorem.

**Unit-II**

**Magnetic Field and Maxwell Equations:** Biot - Savart Law, Ampere’s Law, Magnetic Vector potentials, Force on a moving charge, Differential Current Element, Force and Torque on a Closed Circuit, Magnetic Boundary Conditions, The Magnetic Circuit, Faraday’s Law, Maxwell’s Equations in Point and Integral form for Free Space, Good Conductors & Lossy Dielectrics for Sinusoidal Time Variations & Static Fields, Retarded Potentials.

**Unit-III**

**The Uniform Plane Wave:** Plane Waves & its Properties, Wave Equation for Free Space and Conducting Medium, Propagation of Plane Waves in Lossy Dielectrics, Good Dielectrics & Good Conductors. The Pointing Vectors and Power Considerations, Skin Effect, Reflection of Uniform Plane Waves (Normal & Oblique Incidence).

**Unit-IV**

**Transmission Lines and Wave Guides:** The Transmission Line Equations, Graphical Methods, Smith Chart, Time – domain and Frequency – domain Analysis. Reflection in Transmission Lines, SWR, TE, TM, TEM waves, TE and TM modes in Rectangular and Circular Waveguides, Cut-off & Guided Wavelength. Wave Impedance and Characteristic Impedance, Dominant Modes, Power Flow in waveguides, Excitation of waveguides, Dielectric waveguides.

**Text/Refrence Books:**

1. Hayt W H., Engineering Electromagnetics, Tata McGraw Hill, 6th Edition.
2. Jordan E C & Balamain K G, Electromagnetic Waves and Radiating Systems, PHI.2 David K. Chang, Field and Electromagnetics, Addison Wesley.

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| **EEP-318A** | **Computer Architecture** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various types of electrical measurements and measuring instruments. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Understand the concepts of microprocessors, their principles and practices. | | | | | | |
| **CO2** | Write efficient programs in assembly language of the 8086 family of microprocessors | | | | | | |
| **CO3** | Organize a modern computer system and be able to relate it to real examples | | | | | | |
| **CO4** | To study the different types of memory organization | | | | | | |

**UNIT-1**

**Introduction to computer organization**

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control UNIT operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

**UNIT-2**

**Memory organization**

System memory, Cache memory - types and organization, Virtual memory and its implementation,

Memory management UNIT, Magnetic Hard disks, Optical Disks. Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling,

**UNIT-3**

**Input – output Organization**

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

**UNIT-4**

**16 and 32 microprocessors**

80x86 Architecture, IA **–** 32 and IA **–** 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

**Text/Reference Books**

1. V. Carl, G. Zvonko and S. G. Zaky, **“**Computer organization**”**, McGraw Hill, 1978.

2. B. Brey and C. R. Sarma, **“**The Intel microprocessors**”**, Pearson Education, 2000.

3. J. L. Hennessy and D. A. Patterson, **“**Computer Architecture A Quantitative Approach**”**, Morgan Kauffman, 2011.

4. W. Stallings, **“**Computer organization**”**, PHI, 1987.

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| **EE-309A** | **Microprocessors** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of microprocessors and programing | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Do assembly language programming | | | | | | |
| **CO2** | Do interfacing design of peripherals like I/O, A/D, D/A, timer etc | | | | | | |
| **CO3** | Develop systems using different microcontrollers | | | | | | |
| **CO4** | Understand the architecture of 8051 | | | | | | |

UNIT 1

Fundamentals of Microprocessors: Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

UNIT 2

**The 8051 Architecture**: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

UNIT 3

Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, and Subroutine instructions

**UNIT 4**

**Memory and I/O Interfacing**: Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, and memory devices. Application: LED, LCD and DC Motor interfacing

Text / References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “ 8051 Microcontroller” , Delmar Cengage Learning,2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996

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| **EEO-325A** | **Computer Networks** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various computer networks and their programming | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To develop an understanding of modern network architectures from a design and  performance perspective | | | | | | |
| **CO2** | To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs). | | | | | | |
| **CO3** | To provide an opportunity to do network programming | | | | | | |
| **CO4** | To provide a WLAN measurement ideas. | | | | | | |

**UNIT 1**

**Data communication Components:** Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

**UNIT 2**

**Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

**UNIT 3**

**Network Layer:** Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

**UNIT 4**

**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

**Suggested reference books**

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.

3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, UNITed States of America.

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| **EENO-303A** | **Big Data Analysis** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To provide knowledge of Big Data Analytics and Distributed File Systems. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To learn in details the concepts of big data | | | | | | |
| **CO2** | Expose the criteria of big data analytics and big data storage | | | | | | |
| **CO3** | To explore knowledge of big data compression techniques | | | | | | |
| **CO4** | To explore learning of big data tools and state-of-the-art knowledge with implementation for big data | | | | | | |

**UNIT 1**

**Big Data**: Background, definition and features of big data, big data value, development of big data, challenges of big data, NoSQL databases, technologies related to big data including cloud computing, Internet of Things, data center, Hadoop, relationship between IoT and big data, relationship between hadoop and big data, big data generation and acquisition includes data collection, data transmission, data pre-processing, big data applications.

**UNIT 2**

**Big Data Analytics and Storage**: Big data analysis, big data analytic methods and tools, Pig, Hive, Flume, Mahout, Big data storage, distributed storage system for massive data, storage mechanism for big data GFS, HDFS, HBase, MongoDB, Cassandra, big data storage deduplication techniques, fixed-size and variable-size blocks based deduplication, content defined chunking, frequency based chunking, byte and multibyte indexing techniques, Cloud storage.

**UNIT 3**

**Big Data Compression**: Big data delta compression, Xdelta implementation, Message Digest (MD5), Secure Hash Algorithm (SHA-1/SHA-256), Gear Hash, Tiger Hash, Rabin and Incremental Secure Fingerprint based deduplication, lossless duplicate and similar data elimination approaches, Parallel deduplication and compression using PCOMPRESS, Scalable Decentralized Deduplication Store (SDDS) using Cassandra.

**UNIT 4**

**Big Data Processing:** Installation procedure with system requirements for Apache Hadoop, Cassandra, Spark, Pig, Hive, HBase, MongoDB large scale distributed storage systems, Map Reduce programming model working, YARN architecture, Apache Pig and Hive architecture, Single node and Multi-nodes Hadoop Cluster Set up and running a Big Data example, NoSQL implementation.

Text/Reference Books:

1. "Big Data" by Viktor Mayer-Schönberger, Kenneth Cukier, ISBN:978-0544002692, Eamon Dolan/Houghton Mifflin Harcourt 2013.

2. “Big Data Now”, by O’Reilly Media Inc., ASIN: B0097E4EBQ, O’Reilly 2012.

3. “Hadoop Operation”, by Eric Sammer, ISBN: 978-1449327057, O’Reilly 2012.

4. “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, by Donald Miner, Adam Shook, ISBN:978-1449327170, O’Reilly 2012.

5. “Programming Hive”, by Edward Capriolo, ISBN: 978-1449319335,O’Reilly 2012.

6. “HBase: the Definitive Guide”, by Lars George, ISBN: 978-1449396107, O’Reilly 2011.

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| **EENO-305A** | **VLSI Circuits** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To make students aware about the CMOS logic design | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand Transistor-Level CMOS Logic Design. | | | | | | |
| **CO2** | To learn Estimation and Optimization of combinational circuits using RC delay models and logical efforts | | | | | | |
| **CO3** | To design models of moderately sized CMOS circuits that realize specified digital functions. | | | | | | |
| **CO4** | To make an understanding of the characteristics of CMOs circuit construction. | | | | | | |

**UNIT-I**

Introduction to MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, MOSFET as a Switch, Threshold voltage, Body effect. MOS Device Design Equations, Basic DC equations, Short Channel Effects and Device Models – Scaling Theory, Threshold Voltage Variation, Mobility Degradation with Vertical Field, Velocity Saturation, Hot Carrier Effects, Output Impedance Variation with Drain- Source Voltage, MOS Device Models, Small Signal AC Characteristics and  Modeling of MOS Transistors using SPICE.

**UNIT-II**

Introduction, Voltage Transfer Characteristic (VTC), Noise Immunity and Noise margins, Resistive-Load Inverter, Inverters with n-Type MOSFET Load and CMOS Inverter, DC Characteristics of CMOS Inverter, Calculation of VIL, VIH, VOL, VOH and Vth, Design of CMOS Inverters, Supply Voltage Scaling in CMOS Inverters, Power and Area considerations.

**UNIT-III**

Switching Characteristics of CMOS Inverter-  Delay-Time Definitions, CMOS Propagation Delay,  Calculation of Delay times, Estimation of Interconnect parasitic- Interconnect Capacitance Estimation, Interconnect Resistance Estimation, Layout of an Inverter,  Calculation of Interconnect Delay-  RC Delay Models,  The Elmore Delay,  Buffer Chains, Low Swing Drivers, Power Dissipation-Switching, Short-Circuit and Leakage Components of Energy and Power,  Power-Delay Product, Power Distribution and Performance Optimization of Digital Circuits by Logical Effort Sizing; CMOS Ring Oscillator Circuit.

**UNIT-IV**

COMBINATIONAL MOS LOGIC CIRCUITS- CMOS Logic Circuits (NAND, NOR and Complex Logic Gates, Multiplexers etc.), CMOS Transmission Gates (Pass Gates), Pseudo nMOS logic, Dynamic CMOS logic, Clocked CMOS logic and CMOS Domino logic. Sequential MOS logic circuits-Behavior of Bistable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop.

Subsystem design process- design of 4-bit shifter, arithmetic building blocks like adders, multipliers and ALU.

Text/Reference Books:

1. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits – Analysis and Design”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: a design perspective”, 2nd Edition, Pearson Education, 2003.
3. David A. Hodges, Horace G. Jackson, Resve A. Saleh, “Analysis and Design of Digital Integrated Circuits: In Deep Submicron Technology”, McGraw, 2003.
4. David A. Johns and Ken Martin, “Analog Integrated Circuit Design” John Wiley and Sons Inc., 1997.
5. Neil Weste and David Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Addison-Wesley, 2010

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| **EENO-307A** | **Power Plant Engineering** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| 3 | 0 | 0 | 3 | 75 | 25 | 100 | 3 |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of different types of power plants for power generation. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| CO1 | Illustrate working of coal and gas based power plants and their combined operations | | | | | | |
| CO2 | Illustrate working of nuclear fission reaction based power plants and types of reactors | | | | | | |
| CO3 | Illustrate working of different non-conventional power plants like geothermal, ocean energy based and biogas based power generation. | | | | | | |
| CO4 | Evaluate cost of power generation and to know about economics of power generation. | | | | | | |

##### UNIT 1

**Coal and Gas Based Power Plants:** Working of Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, steam turbines, condensers, steam and heating rates, sub-systems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and co-generation systems.

**Combined Operation of Power Plants**: Gas turbine and combined cycle power plants, components of gas turbine power plants, combined cycle power plants.

**UNIT 2**

**Nuclear Power Plants and Nuclear Reactors**: Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

**UNIT 3**

**Non-Conventional Power Generation:** Hydroelectric power plants, classification Hydroelectric power plants, typical layout and components, principles of wind power generation, tidal power generation, solar PV cells for power generation and geothermal power generation ,biogas power plant and Fuel cells.

**UNIT 4**

**Economic Considerations:** Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

##### Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill,2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill,2010.

3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nded., McGraw Hill,1998.

4. Non-Conventional energy sources by Rai G D, Khanna Publishers.

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| **EE-313A** | **Power System Lab-I** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time(Hrs)** |
| **0** | **0** | **2** | **1** | **60** | **40** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various relays, insulators and transmission line modelling | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand various types of relay | | | | | | |
| **CO2** | To study parallel operation of alternator | | | | | | |
| **CO3** | To understand the concept of various insulators | | | | | | |
| **CO4** | To understand the concept of transmission line modeling | | | | | | |

**LIST OF EXPERIMENTS**

1. Experiment to find out the dielectric strength of transformer oil.

2 Experiment to find zero sequence component of three phase line.

3 Draw the characteristics of thermal overload relay.

4. Experiment to study an IDMT over current relay & plot it's characteristic curves i.e. graph between current & time.

5 Experiment to study differential relay characteristics.

6 Experiment to measure the ABCD parameters of a given transmission line, also study Ferranti effect.

7 Experiment to study Parallel operation of two alternators.

8 Experiment to plot the power angle characteristics of given transmission line.

9 Experiment to find the string efficiency of a string insulator with/without guard rings.

10 Experiment to study the characteristics of transmission line for t-network & pie- network.

11 Testing of a current transformer & find Ratio Error & Phase angle error for various burdens.

12 To study various types of distance relay.

13 Experiment to study fault current using sequence impedance network.

NOTE: At least 10 experiments are to be performed with at least 8 from above list, remaining 2 may either be performed from the above list or designed & set by concerned institution as per the scope.

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| **EE-315A** | **Microprocessors Lab** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time(Hrs)** |
| **0** | **0** | **2** | **1** | **60** | **40** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of microprocessor kit, assembly language. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand the 8086 Trainer Kit | | | | | | |
| **CO2** | To study the ramp, triangular waveform | | | | | | |
| **CO3** | To understand the RAM location | | | | | | |
| **CO4** | To generate the various waveform | | | | | | |

**LIST OF EXPERIMENTS**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. a) Familiarization with 8086 Trainer Kit.  b) Familiarization with Digital I/O, ADC and DAC Cards.  c) Familiarization with Turbo Assembler and Debugger S/Ws.  2. Write a program to arrange block of data in  a) Ascending and b) Descending order.  3. i) Program for finding largest number from an array. ii) Program for finding smallest number from an array.  4. Write a program to find out any power of a number such that Z = XN, Where N is programmable and X is unsigned number.  5. Write a program to generate:  (i) Sine wave form (ii) Ramp waveform (iii) Triangular waveform using DAC card.  6. Write a program to measure frequency/time period:  (i) Sine wave form (ii) Ramp waveform (iii) Triangular waveform using DAC card.  7. Copy a byte in TCON to register R2 using at least four different methods.  8. Store the no. 8DH in RAM location 30 H to 34 H.  9. Write a program load the unsigned no. found in internal RAM location 5H,26H& 27 H together and put the result in RAM locations 31H MSB and 30H LSB.  10. Find the address of first two internal RAM locations between 20H and 60H which contain consecutive nos. if so, set the carry to1, and else clear the flag.  NOTE: At least 10 experiments are to be performed with at least 8 from above list, remaining 2 may either be performed from the above list or designed & set by concerned institution as per the scope.   |  |  |  |  | | --- | --- | --- | --- | |  | | | | |  |  | |  | |  | |  | | |  | | | | |

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| **EE-317A** | **Control Systems Lab** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time(Hrs)** |
| **0** | **0** | **2** | **1** | **60** | **40** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various controller and compensation technique. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand the various simulator | | | | | | |
| **CO2** | To study the various compensation technique | | | | | | |
| **CO3** | To study the speed control of dc motor | | | | | | |
| **CO4** | To study the various error detector. | | | | | | |

**LIST OF EXPERIMENTS:**

1. Experiment to study linear system simulator.

2. To study the stroboscope & measure the shaft speed

2. Experiment to study light intensity control using P & PI controller with provision for and transient speed control.

3. Experiment to study D.C motor speed control.

4. Experiment to study the stepper motor characteristics and its control through microprocessor kit.

5. Experiment to study Temperature control system.

6. Experiment to study Compensation design.

7. Experiment to study Digital control system.

8. Experiment to study Synchros.

10. Experiment to study AC Position control system.

11. Experiment to study Potential Metric Error detector.

NOTE: At least 10 experiments are to be performed with at least 8 from above list, remaining 2 may either be performed from the above list or designed & set by concerned institution as per the scope.

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| **EE-302A** | **Power System-II** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **1** | **0** | **4** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To enable students to analyses power system networks, faults in power system, transient and bus impedance algorithm | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Understand the concepts of per unit system | | | | | | |
| **CO2** | Understand the various faults in power system | | | | | | |
| **CO3** | Understand the transients in power system | | | | | | |
| **CO4** | Determine methods of impedance matrix calculation. | | | | | | |

**UNIT-I**

**Introduction:** Characteristics & representation of components of a power system, synchronous machines, transformers, lines cables & loads. Single line diagram of a power system Flow of zero sequence current, zero sequence impedance diagrams of power system with different types of connections of three phase transformers.

**Per unit system:** Per unit method of representing quantities, Advantages and disadvantages of per unit system, determination of base impedance, per unit impedance of two winding transformer.

**UNIT-II**

**Symmetrical faults**: calculation of fault currents, use of current limiting reactors.

**Unsymmetrical faults**: Types of transformation in power system analysis, symmetrical components transformation, sequence impedance of power system elements, Sequence network of power system analysis of unsymmetrical short faults, Network analysis & its application to interconnected system.

**UNIT-III**

**Transients in Power Systems:** Transient electric phenomenon, lighting & switching surges, traveling waves, Surge impedance and velocity of propagation, reflection & refraction of waves, reflection & refraction of waves with different line termination, equivalent circuit for travelling wave studies, Bifurcated line, Travelling wave on a line terminated by inductance, capacitance

**UNIT-IV**

**Bus Impedance and admittance matrices**: Building algorithms for bus impedance matrix, modification of bus impedance matrix for change of reference bus and for network changes, formation of bus admittance matrix and modification of three-phase network elements, treatment under balanced and unbalanced excitation, transformation matrices, and unbalanced elements.

**Reference Books:**

1. Elements of Power System Analysis by W.D. Stevenson.

2. Electric Power System by B.M. Weddy.

3. The transmission & Distribution of Electric Energy by H. Cotton.

4. Power System & Protection by S.S. VADHERA

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| **HM-901A** | **Organizational Behavior** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various methods adopted in organizational behavior. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To study the structure of organization | | | | | | |
| **CO2** | Understand the behavior of individual | | | | | | |
| **CO3** | To study the group behavior in an organization. | | | | | | |
| **CO4** | Understand the human resource management policies. | | | | | | |

**UNIT-1**

Introduction to organization, organization and managers, manager’ roles and skills, behavior at work, introduction to organization behaviour, major behavioural science disciplines contributing to OB, challenges and opportunities managers have in applying OB concepts, OB model (including motivation models) and levels of OB model

**UNIT-2**

Introduction to individual behaviour, values, attitudes, job satisfaction, personality, perception and individual decision making, learning, motivation at work, managing emotions and stress (Meaning-Definition Stress and job performance relationship Approaches to stress management (Coping with stress)

**UNIT-3**

Introduction to group behaviour, foundations of group behaviour, concept of group and group dynamics, types of groups, formal and informal groups, theories of group formation, group norms, group cohesiveness, group decision making, inter group behaviour, concept of team vs. group, types of teams, building and managing effective teams, leadership theories and styles, power and politics, conflict and negotiation.

**UNIT-4**

Foundations of organization structure, organization design, organization culture, organization change, managing across cultures, human resource management policies and practices, diversity at work.

**Books Recommended:**

1. Robbins, S. P/ Judge, T. A/ Sanghi, S., Organizational Behavior, Pearson Publication

2. Aswathappa, K., Organisational Behaviour– Text and Problem, Himalaya Publication

3. Pardeshi, P. C., Organizational Behaviour & Principles & Practice of Management,

Nirali publication

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| **EEP-304A** | **Power System Protection** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of different types of circuit breaker, Relay and different types of protection scheme. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Study the arc formation and interruption. | | | | | | |
| **CO2** | Understand the various types of circuit breaker | | | | | | |
| **CO3** | Understand the different types of relays | | | | | | |
| **CO4** | Study various types of protection scheme. | | | | | | |

**UNIT 1**

**Neutral grounding:** Need for neutral grounding, various types of neutral grounding

**Circuit Interruption:** Circuit interruption, theory of arc formation and it’s excitation in DC, AC circuits, restriking & recovery voltage, interruption of capacitive & inductive currents. Rupturing capacity & rating of circuit breakers. Resistance switching

**UNIT 2**

**Circuit-Breakers:** Classification of circuit-breakers, Oil circuit breaker, Air blast circuit breaker, SF6 circuit breaker, Vacuum circuit breaker, HVDC circuit breaker. Auto-restoring of high capacity & H.V. circuit breakers. Breaker operating mechanisms, Types of circuit breaker mountings and enclosure, comparison between different types of circuit breaker

**UNIT 3**

**Protective System:** features of good protective system, elements of relay, terms connected with relay, Electromagnetic attraction and induction relays, Overcurrent Relay, Differential relay, distance or impedance relay, static relays: Need, Essential components of static relay, comparison with electromagnetic relay

**UNIT 4**

**Transformer Protection:** Buchholz protection, Differential protection, restricted earth fault protection

**Alternator protection:** Stator and rotor protection, Merz Price Protection, Balance earth fault protection

**Bus bar Protection:** Differential overcurrent protection, Frame leakage protection

**Transmission line protection:** Time graded protection, Current graded protection, and Differential protection

Reference Books:-

1. Power System Protection & Switchgear, Ravinder Nath, New Age

2. Power System Protection & Switchgear, Badri Ram, MGH

3. Protection & Switchgear, Bhalja, Maheshwari, Oxford

4. Switch gear and protection, J.B. Gupta, Katson Books

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| **EEP-306A** | **Electrical Energy Conservation and Auditing** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of energy conservation act, tariff and energy auditing. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Study the different energy conservation act | | | | | | |
| **CO2** | Understand the various tariff and load management | | | | | | |
| **CO3** | Understand the different types of energy auditing | | | | | | |
| **CO4** | Study various types of motors. | | | | | | |

**UNIT-I**

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

**UNIT-II**

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity.

**UNIT-III**

Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to requirement. Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit.

**UNIT-IV**

Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

**Suggested Books:**

1. Albert: Plant Engineers & Managers Guide to Energy Conservation.

2. Wayne C. Turner Energy management handbook, John Wiley and Sons.

3. Guide to Energy Management, Cape Hart, Turner and Kennedy

4. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council

5. M. K. Lahiri : Saving of Electricity by System Management. M.K. Lahiri Publication

6. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)

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| **EEP-308A** | **Biomedical Signal & Image Processing** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To make students aware about the fundamentals and various techniques of biomedical image processing and to develop the algorithms for image analysis and diagnosis in medical imaging | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand image fundamentals and acquisition techniques | | | | | | |
| **CO2** | To learn Image Enhancement in Spatial and Frequency domain | | | | | | |
| **CO3** | To learn Morphological Image Processing and Image Segmentation. | | | | | | |
| **CO4** | To learn image compression and representation. | | | | | | |

**UNIT-I**

Fundamentals of Digital Image: Image formation, visual perception, CCD & CMOS Image sensor, Image sampling: Two dimensional Sampling theory, Nonrectangular grid and Hexagonal sampling, Optimal sampling, Image quantization, Non uniform Quantization, Image formats. Types of pixel Operations, Types of neighborhoods, adjacency, connectivity, boundaries, regions, 2D- convolution, Color models.

**UNIT-II**

Image Enhancement in Spatial and Frequency domain: Basic gray level transformations, histogram processing, Smoothing operations, Edge Detection-derivative based operation, filtering in frequency domain, 2D-DFT, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering.

**UNIT-III**

Morphological Image Processing: Dilation and Erosion, Opening and Closing, Hit-or-Miss transformation, Boundary Extraction, Region filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening, Skeletons, Pruning.

Image Segmentation: Detection of discontinuities, Point-line- edge detection, Linear and Circular Hough Transform, Basic Global and Adaptive Thresholding, Region Based segmentation, K-Means Clustering

**UNIT-IV**

Image Compression: Fundamentals of Image compression models, Lossless compression: variable length coding, LZW coding, Arithmetic coding, Lossy compression: Wavelet and DCT coding, Predictive coding.

Representation and Description: Image features, Feature extraction, Chain code, Moments

Text Books:

1. Digital Image Processing, Gonzalez and Woods- Pearson Education

2. Digital Image Processing, S. Sridhar – Oxford University Press.

3. Fundamentals of Digital Image Processing, A.K. Jain .P.H.I.

4. Digital Image Processing, William Pratt- John Wiley.

5. Feature Extraction and Image Processing, Mark S. Nixon and Alberto S. Aguado.

6. Digital Image Processing and Analysis, Chanda Majumder- Printice Hall India.

7. Medical image processing, Geoff Dougherty editor, springer.

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| **EEO-320A** | **Electrical Materials** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various types of electrical engineering materials. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | Understand the concepts of conductors | | | | | | |
| **CO2** | To study the various types of insulators | | | | | | |
| **CO3** | Classify the different types of magnetic materials | | | | | | |
| **CO4** | To study the different types of processes. | | | | | | |

**UNIT-I**

Conductors, Properties of conductors, ACSR, High resistivity materials and their properties, Alloys, Soldering and brazing materials, superconductivity, super conductor materials and their applications.

**UNIT-II**

Insulators, classifications of insulators, dialectical materials, glass and ceramics, refractory materials and their uses, optical fibers, laser and opto-electronics materials, semiconductor materials, properties of semiconductor materials, thermosetting and thermoplast materials.

**UNIT-III**

Classification of material, Dia, Para, and Ferro magnetic materials-curie law and curie Weiss law (qualitative study).Ferromagnetism-Qualitative study of domain theory – Hysteresis phenomena. Hard and soft magnetic material and their applications. Ferrites, Structure and property.

**UNIT-IV**

Processes used in Plano technology e.g. Lapping, polishing, cleaning, masking, photolithography, diffusion, oxidation and metallization, welding, wire bonding, packaging and encapsulation, Heating- induction and dielectric, Electron beam welding and cutting, annealing, cold &Hot rolling.

**REFERENCES :**

1. SP Seth “A course in Electrical Engg. Material” (Dhanpat Rai & Sons).

2. Dekker, “Electrical Engg. Materials” (PHI).

3. PL Kapoor,”A text book of Electrical Engg. Material” (Khanna Publishers).

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| **EEO-322A** | **Strength of Materials** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of calculation of strength of different types of geometry. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand the nature of stresses developed in simple geometries | | | | | | |
| **CO2** | To calculate the elastic deformation occurring in various simple geometries | | | | | | |
| **CO3** | To calculate the moment of inertia in various simple geometries | | | | | | |
| **CO4** | To calculate the torsion and stress in various simple geometries | | | | | | |

**UNIT-1**

Deformation in solids- Hooke’s law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr’s circle.

**UNIT-2**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

**UNIT-3**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell’s reciprocal theorems.

**UNIT-4**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

**Text Books:**

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata

McGraw Hill Publishing Co. Ltd., New Delhi 2005.

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| **EENO-306A** | **Internet of Things** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | To make students aware about the Internet of Things architecture(IoT) and IoT sensor’s application in IoT | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand basics of Internet of Things architecture. | | | | | | |
| **CO2** | To understand the role of cloud and fog in IoT | | | | | | |
| **CO3** | To understand the role of sensors in IoT | | | | | | |
| **CO4** | To understand Software Hardware Frameworks | | | | | | |

**UNIT-I**

**Introduction to Internet of Things(IoT):** IoT definition, Characteristics, IoT Complete Architectural Stack – IoT enabling Technologies, Protocols for IoT – Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. Cloud Computing Introduction: Service Models, Deployment Models, Virtualization Concepts, Different Cloud Platforms – Amazon AWS, Microsoft Azure, Google and IBM Cloud. IoT and the Cloud, Role of Cloud Computing in IoT.

**UNIT-II**

**FOG COMPUTING:** Fog Computing-Definition-Characteristics-Application Scenarios - Issues –Fog Computing and Internet of Things-Pros and Cons-Myths of Fog Computing -Need and Reasons for Fog Computing Fog Computing and Edge Computing-IoT , FOG, Cloud-Benefits, Fog architecture , Fog Protocol-Fog Kit- Proximity Detection Protocols- DDS/RTPS computing protocols

**UNIT-III**

**Sensors for IoT Applications:** Generations of IoT Sensors: Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics.

**UNIT-IV**

**Software Hardware Frameworks:** Software: open Framework - “Arduino” Language (C/C++) - Hardware: Desktop / Laptop / Raspberry Pi - How to approach a programming problem? Sensors and Hardware for IoT, Understanding hardware platforms – Arduino, Raspberry Pi, Node MCU. Sensors and Software: Understanding Processing Code Structure, variables and flow control, Interfacing to the Real World

References:

1. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, Springer

2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-On-Approach)”, VPT, 2014.

3. John Rhoton, Cloud Computing Explained: Handbook for Enterprise Implementation 2013 edition.

4. Raj kumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Elsevier publication, 2013

5. Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design by Omesh Tickoo, Ravi Iyer 2016

6. Programming Interactivity, Second Edition By Josha Noble, 2012

7. Programming the Raspberry Pi: Getting Started with Python 2E, 2016

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| **EE-310A** | **Electrical Measurements and Measuring Instrumentation** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various types of electrical measurements and measuring instruments. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To study the generalized instruments. | | | | | | |
| **CO2** | To study the various types of measuring instruments | | | | | | |
| **CO3** | Understand the concept of wattmeter and energy meter | | | | | | |
| **CO4** | To study the different types of bridge. | | | | | | |

**UNIT-1**

**MEASURING SYSTEM FUNDAMENTALS**: Classification of instruments (Absolute & Secondary Instruments: indicating, recording &integrating instruments: based upon Principle of operation). Generalized instrument (Block diagram, description of blocks). Three forces in electromechanical indicating instrument (Deflecting, controlling & damping forces). Comparison between gravity & spring controls: comparison of damping methods & their suitability bearing supports, pivot-less supports (simple & taut-band). Scale information, instrument cases (covers).

**UNIT – II**

**MEASURING INSTRUMENTS**: Construction, operating principle, Torque equation, shape of scale, use as Ammeter or as Voltmeter (Extension of Ranges). Advantages & disadvantages, errors (both on AC/ DC) of PMMC types, electrodynamic type, moving iron type (attraction, repulsion & combined types). Hot wire type & Induction type, electrostatic type instruments. Introduction of Q meter

**UNIT – III**

**WATTMETERS & ENERGY METERS**: Construction, operating principle, torque equation, shape of scale, errors, Advantages & disadvantages of Electrodynamics & induction type watt meters; single phase induction type Energy meter, Compensation & creep in energy meter.

**POWER FACTOR METERS**: Construction, operating principle, torque equation, advantages & disadvantages of Single phase power factor meters (Electrodynamics & moving iron types)

**UNIT – IV**

**LOW & HIGH RESISTANCE MEASUREMENTS**: Kelvin’s double bridge method, Difficulties in high resistance measurements, Measurement of high resistance by direct deflection, loss of charge method, Megaohm Bridge & meggar.

**A. C. BRIDGES**: General balance, Circuit & Phasor diagram, applications, advantages/disadvantages of: Maxwell’s inductance, inductance-capacitance, Hays, Anderson, Owens, De-Sauty’s, Schering & Weins Bridges.

**REFERENCE BOOKS:**

1. A Course in Elect. & Electronics Measurement & Instrumentation by A.K. Sawhney; Khanna Pub.

2. Electronics & Electrical Measurement & Instrumentation by J.B. Gupta, Kataria& Sons.

3. Electronics Instrumentation & Measurement technique, W.D. Copper &A.dHelfrick.

4. Measuring Systems by E.O. Doeblin; TMH.

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| **EE-312A** | **Power System Lab -II** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time(Hrs)** |
| **0** | **0** | **2** | **1** | **60** | **40** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of programming in power system. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To develop the program for Y- bus and Z-bus | | | | | | |
| **CO2** | To develop the program load flow analysis. | | | | | | |
| **CO3** | To develop the program for different mathematical operation. | | | | | | |
| **CO4** | To develop the program for Gauss Seidal method. | | | | | | |

**List of Experiments:**

1. Develop a program to do the following mathematical operations:

i) Transpose of a matrix

ii) Multiplication of two matrices

iii) Addition & subtraction of two matrices.

2. Write a program to formulate Y-Bus by non- singular transformation Y Bus = [A], T[= y] [A].

3. Develop a program to solve a set of 4 simultaneous liner equations using Gaussian Elimination

method.

4. Develop a program to calculate Z bus of a given network using building algorithm. Assume that no mutual coupling is involved in between the different elements.

5. The Gauss Seidel method to find the solution of following equations

X1 + X1X2 + X3 = 10

X1 + X2 + X3 = 6

X1 X2 – X3 = 2

6. You have given with a 6 bus system. Apply load flow technique using Gauss Seidel method to

solve up to two iterations.

7. Develop a program to find Eigen Values for given Matrix.

8. Develop a program to determine the bus impedance matrices for the given power system network.

9. Develop a program to determine the admittance matrices for the given power system network.

10. To conduct the load flow analysis of power system networks (not more than 6 bus) on any dedicated using Newton Raphson method.

Note: At least seven experiments should be performed from above list on any dedicated software platform. Remaining three experiments may either be performed from above list or designed & set by concerned institution as per scope of syllabus.

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| **EE-314A** | **Measurements and Instrumentation Lab** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time(Hrs)** |
| **0** | **0** | **2** | **1** | **60** | **40** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of various types of instruments and measurement of resistance, inductance and capacitances | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To understand the different types of meters. | | | | | | |
| **CO2** | To measure the low and high resistance | | | | | | |
| **CO3** | To calculate the inductance and capacitance using bridge. | | | | | | |
| **CO4** | To measure the energy and power . | | | | | | |

**LIST OF EXPERIMENTS:**

1. To identify the meters from the given lot w.r.t application.

2. To convert & calibrate a D’Arsonnal type galvanometer into a voltmeter & an ammeter.

3. To calibrate an energy meter with the help of a standard wattmeter & a stop watch

4. To measure power & p.f. in 3-phase circuit by 2-watmeter method using P. T and C.T.

5. To measure capacitance by De Sauty’s bridge.

6. To measure inductance by Maxwell’s bridge.

7. To measure frequency by Wien’s bridge.

8. To measure magnitude & phase angle of a voltage by rectangular type potentiometer.

9. To measure magnitude & phase angle of a voltage by polar type potentiometer.

10. To measure low resistance by Kelvin’s Double bridge.

11. To measure high resistance by loss of charge method.

12. To measure R,L,C, by Q metre

Note: At least seven experiments should be performed from above list. Remaining three experiments may either be performed from above list or designed & set by concerned institution as per scope of syllabus.

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| **EEN-316A** | **Electronic Design Lab** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time(Hrs)** |
| **0** | **0** | **2** | **1** | **60** | **40** | **100** | **3** |
| **Program Objective (PO)** | The main objective of the course is to impart the students with the knowledge of design of various types of electronics circuit. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **After completion of course students will be able to** | | | | | | | |
| **CO1** | To study the characteristics of different types diode. | | | | | | |
| **CO2** | To plot the characteristics of different types of BJT. | | | | | | |
| **CO3** | Design of half and full wave rectifier. | | | | | | |
| **CO4** | Characteristics of special devices-UJT and SCR | | | | | | |

**List of Experiments:**

1. V-I Characteristics of Silicon and Germanium diodes and measurement of static and dynamic resistances

2. Zener diode characteristics and its application as voltage regulator

3. Design, realization and performance evaluation of half wave rectifiers without filters and with LC & pi section filters

4. Design, realization and performance evaluation of full wave rectifiers without filters and with LC & pi section filters

5. Plotting the characteristics of BJT in Common Base configuration and measurement of h-parameters

6. Plotting the characteristics of BJT in Common Emitter configuration and measurement of h-parameters

7. Plotting the characteristics of JFET in CS configuration and measurement of Trans-conductance and Drain resistance

8. BJT biasing circuits

9. FET biasing circuits

10. Common Emitter BJT Amplifier and measurement of Gain, bandwidth, input and output impedances

11. Common Source FET Amplifier and measurement of Gain, bandwidth, input and output impedances

12. Emitter Follower / Source Follower circuits and measurement of Gain, bandwidth, input and output impedances

13. Characteristics of special devices-UJT and SCR

Note: At least seven experiments should be performed from above list on any dedicated software platform. Remaining three experiments may either be performed from above list or designed & set by concerned institution as per scope of syllabus.