JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. (ELECTRICAL POWER SYSTEMS/ POWER SYSTEM CONTROL AND AUTOMATION/ ELECTRICAL POWER ENGINEERING)

EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Advanced Power System Analysis	25	75	4	0	0	4
PC-2	Advanced Power System Protection	25	75	4	0	0	4
PC-3	Modern Control Theory	25	75	4	0	0	4
PE-1	1. EHV AC Transmission 2. High Voltage Engineering 3. Advanced Digital Signal Processing	25	75	3	0	0	3
PE-2	1. Power Quality 2. Microcontrollers and applications 3. Distribution Automation	25	75	3	0	0	3
OE-1	***Open Elective – I**	25	75	3	0	0	3
Laboratory I	Power & Energy Systems Lab - I	25	75	0	0	3	2
Seminar I	Seminar – I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Power System Dynamics and Control	25	75	4	0	0	4
PC-5	Flexible AC Transmission Systems (FACTS)	25	75	4	0	0	4
PC-6	Power System Operation and Deregulation	25	75	4	0	0	4
PE-3	1. Gas Insulated Systems(GIS) 2. Programmable Logic Controllers and applications 3. Energy Auditing Conservation and Management	25	75	**3**	0	0	3
PE4	1. Reactive Power Compensation and Management 2. Power System Reliability 3. Voltage Stability	25	75	**3**	0	0	3
OE-2	***Open Elective – II**	25	75	3	0	0	3
Laboratory II	Power & Energy Systems Lab - II	25	75	0	0	3	2
Seminar II	Seminar –II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review II	100	0	0	0	22	8
Total	**200**	**100**	**0**	**3**	**22**	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review III	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	100	0	0	0	16
Total	**100**	**100**	**0**	**0**	**24**	**24**

*Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

ADVANCED POWER SYSTEM ANALYSIS
(Professional Core - I)

Prerequisite: Computer Methods in Power Systems

Course Objectives:
- To analyze a Power System Network using graph theory.
- To interpret the formation of Network matrices.
- To construct the necessity of load flow studies and various methods of Analysis.
- To examine short circuit analysis using Z_{Bus}.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Remember proper mathematical models for analysis.
- Conclude methodologies of load flow studies for the power network.
- Apply contingency Analysis.
- Analyze power system studies.

UNIT-I:
Admittance Model and Network Calculations, Branch and Node Admittances, Mutually Coupled Branches in Y_{BUS} , An Equivalent Admittance Network, Modification of Y_{BUS} , Network Incidence Matrix and Y_{BUS} , Method of Successive Elimination, Node Elimination, Triangular Factorization, Sparsity and Near Optimal Ordering.

UNIT-II:
Impedance Model and Network Calculations, the BUS Admittance and Impedance Matrices, Thevenin's   Theorem and Z_{BUS} ,Algorithms for building Z_{BUS} Modification of existing $Z_{BUS,}$ Calculation of Z_{BUS} elements from $Y_{BUS,}$ Power Invariant Transformations, Mutually Coupled Branches in $Z_{BUS.}$

UNIT-III:
Gauss Seidel method, N-R Method, Decoupled method, fast decoupled method, comparison between power flow solutions. DC load flow.

UNIT-IV:
Z_{BUS} Method in Contingency Analysis, Adding and Removing Multiple Lines, Piecewise Solution of Interconnected Systems, Analysis of Single Contingencies, Analysis of Multiple Contingencies, Contingency Analysis of DC Model, System Reduction for Contingency and Fault Studies.

UNIT-V:
Fault Analysis: Symmetrical faults-Fault calculations using Z_{BUS}- Fault calculations using Z_{BUS} equivalent circuits –Selection of circuit breakers- Unsymmetrical faults-Problems on various types of faults.

TEXT BOOKS:
1. John J. Grainger and W. D. Stevenson, "Power System Analysis"- T.M.H. Edition.
2. Modern Power System Analysis– by I. J. Nagrath & D. P. Kothari Tata McGraw – Hill Publishing Company Ltd, 2nd edition.

REFERENCE BOOKS:
1. Power System Analysis and Design by J. Duncan Glover and M.S. Sarma., Cengage 3rd Edition.
2. Olle. L.Elgard, "Electrical Energy Systems Theory"-T.M.H. Edition.
3. Power systems stability and control, Prabha Kundur, The McGraw – Hill companies**.**
4. Power System Operation and Control, Dr. K. Uma Rao, Wiley India Pvt. Ltd.
5. Operation and Control in Power Systems, PSR Murthy, Bs Publications.
6. Power System Operation, Robert H. Miller, Jamesh H. Malinowski, The McGraw – Hill companies**.**
7. Power Systems Analysis, operation and control by Abhijit Chakrabarti, Sunitha Halder, PHI 3/e , 2010

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

ADVANCED POWER SYSTEM Protection
(Professional Core - II)

Prerequisite: Switch Gear and Protection
Course Objectives:
- To distinguish all kinds of circuit breakers and relays for protection of Generators, Transformers and feeder bus bars from Over voltages and other hazards.
- To generalize neutral grounding for overall protection.
- To illustrate the phenomenon of Over Voltages and its classification.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Understand the basic function of a circuit breaker, all kinds of circuit breakers and differentiate fuse and circuit breakers under fault condition.
- Describe the necessity for the protection of alternators, transformers and feeder bus bars from over voltages and other hazards
- Illustrate neutral grounding, and how over voltages can be generated and how system can be protected against lightning and switching transient over voltages with various protective means
- Identify operation and control of microprocessor based relays.

UNIT-I:
Static Relays: Advantages of static relays-Basic construction of static relays-Level detectors-Replica impedance –Mixing circuits-General equation for two input phase and amplitude comparators-Duality between amplitude and phase comparators.
Amplitude Comparators: Circulating current type and opposed voltage type- rectifier bridge comparators, Direct and Instantaneous comparators.

UNIT-II:
Phase Comparators: Coincidence circuit type- block spike phase comparator, techniques to measure the period of coincidence-Integrating type-Rectifier and Vector product type- Phase comparators.
Static Over Current Relays: Instantaneous over-current relay-Time over-current relays-basic principles –definite time and Inverse definite time over-current relays.

UNIT-III:
Static Differential Relays: Analysis of Static Differential Relays –Static Relay schemes –Duo bias transformer differential protection –Harmonic restraint relay.
Static Distance Relays: Static impedance-reactance–MHO and angle impedance relay-sampling comparator –realization of reactance and MHO relay using sampling comparator.

UNIT-IV:
Multi-Input Comparators: Conic section characteristics-Three input amplitude comparator –Hybrid comparator-switched distance schemes –Poly phase distance schemes- phase fault scheme –three phase scheme – combined and ground fault scheme.
Power Swings: Effect of power swings on the performance of distance relays –Power swing analysis-Principle of out of step tripping and blocking relays-effect of line and length and source impedance on distance relays.

UNIT-V:

Microprocessor based Protective Relays: (Block diagram and flowchart approach only)-Over current relays–impedance relays-directional relay-reactance relay .Generalized mathematical expressions for distance relays-measurement of resistance and reactance –MHO and offset MHO relays-Realization of MHO characteristics- Realization of offset MHO characteristics -Basic principle of Digital computer relaying, Introduction to wide area control(qualitative).

TEXT BOOKS:
1. Badri Ram and D.N. Vishwakarma, "Power system protection and Switch gear ", TMH publication New Delhi 1995.
2. T.S. Madhava Rao , "Static relays", TMH publication, second edition 1989.

REFERENCE:
1. Protection and Switchgear, Bhavesh Bhalja, R. P. Mahesheari, Nilesh G. Chothani, Oxford University Press.
2. Electrical Power System Protection, C. Christopoulos and A. Wright, Springer International.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

MODERN CONTROL THEORY
(Professional Core - III)

Prerequisite: Control Systems
Course Objectives
- To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
- To Explain and apply concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability of nonlinear systems and categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

Course Outcomes: Upon completion of this course, students should be able to:
- Apply the knowledge of basic and modern control system for the real time analysis and design of control systems.
- Understand the concepts of state variables analysis.
- Analyze the concept of stability of nonlinear systems and optimal control.

UNIT–I:
Mathematical Preliminaries: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

UNIT-II:
State Variable Analysis: Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

UNIT-III:
Non Linear Systems: Introduction – Non Linear Systems - Types of Non-Linearities – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc;– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

UNIT-IV:
Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method. State feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

UNIT-V:

Optimal Control: Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

TEXT BOOKS:
1. Modern Control System Theory by M. Gopal – new age international -1984
2. Control System Engineering, Nagrath and Gopal - New Age International – Fourth Edition

REFERENCES:
1. Optimal control by Kirck , Dover Publications
2. Advanced Control Theory A. NagoorKani, RBA Publications, 1999
3. Modern Control Engineering by Ogata.K – Prentice Hall - 1997

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

EHV AC TRANSMISSION
(Professional Elective - I)

Prerequisite: Power Systems -**II**
Course objectives:
- To identify the different aspects of Extra High Voltage A.C and D.C Transmission design and Analysis
- To understand the importance of modern developments of E.H.V and U.H.V transmission systems.
- To demonstrate EHV ac transmission system components, protection and insulation level for over voltages.

Course Outcomes: Upon the completion of the subject, the student will be able to
- List the necessity of EHV AC transmission, choice of voltage for transmission, line losses and power handling capability.
- Estimate the Statistical procedures for line designs, scientific and engineering principles in power systems.
- Construct commercial transmission system.

UNIT- I:
E.H.V.A.C. Transmission line trends and preliminary aspect standard transmission voltages – Estimation at line and ground parameters-Bundle conductor systems-Inductance and Capacitance of E.H.V. lines – positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.

UNIT- II:
Electrostatic field and voltage gradients – calculations of electrostatic field of AC lines – effect of high electrostatic field on biological organisms and human beings - surface voltage gradients and maximum gradients of actual transmission lines – voltage gradients on sub conductor.

UNIT- III:
Electrostatic induction in unenergized lines – measurement of field and voltage gradients for three phase single and double circuit lines – un energized lines. Power Frequency Voltage control and over-voltages in EHV lines: No load voltage – charging currents at power frequency-voltage control – shunt and series compensation – static VAR compensation.

UNIT - IV:
Corona in E.H.V. lines – Corona loss formulae- attention of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – frequency spectrum of RI fields – Measurements of RI and RIV.

UNIT- V:
Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics.

TEXT BOOKS:
1. R. D. Begamudre, "EHVAC Transmission Engineering", New Age International (p) Ltd. 3rd Edition.
2. K. R. Padiyar, "HVDC Power Transmission Systems" New Age International (p) Ltd. 2nd revised Edition, 2012.

REFERENCES:
1. S. Rao "EHVAC and HVDC Transmission Engg. Practice" Khanna publishers.
2. Arrillaga. J"High Voltage Direct Current Transmission" 2nd Edition (London) peter Peregrines, IEE, 1998.
3. Padiyar. K.R, "FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007.
4. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

HIGH VOLTAGE ENGINEERING
(Professional Elective - I)

Prerequisite: Power Systems and Electrical & Electronics Instrumentation
Course Objectives:
- To distinguish the Gaseous, liquid and solid dielectric behavior under High Voltage.
- To understand the generation methods of High A.C, DC & Impulse Voltages required for various application.
- To apply the measuring techniques of High A.C., D.C & Impulse voltages and currents.
- To identify the testing techniques for High Voltage Equipment.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Know conduction and breakdown will occur in gases, liquids and solids dielectrics, and different applications of the insulating materials in electrical power apparatus.
- Explain the insulation testing of various components in power systems for different types of voltages, namely power frequency A.C, high frequency, switching or lightning impulses, for which generation of high voltages in laboratories is essential
- Interpret the necessity to measure the voltages and currents accurately, ensuring perfect safety to the personnel and equipment.
- Detect the necessary condition for all the electrical equipment which are capable of withstanding the over voltages which met in service like natural causes lightning or system originated ones switching or power frequency transient voltages.

UNIT- I:
Introduction To High Voltage Engineering: Electric Field Stresses, Gas / Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

UNIT- II:
Break Down In Dielectric Materials: Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law. Liquid as Insulator, pure and commercial liquids, breakdown in pure and commercial liquids. Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

UNIT-III:
Generation & Measurement of High Voltages & Currents : Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators. Measurement of High Direct Current voltages, Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

UNIT-IV:
Over Voltages & Insulation Co-Ordination: Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

UNIT- V:
Testing of Materials & Electrical Apparatus: Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements. Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, and Radio Interference measurements.

TEXT BOOKS:
1. High Voltage Engineering by M.S. Naidu and V. Kamaraju – TMH Publications, 3rd Edition
2. High Voltage Engineering: Fundamentals by E. Kuffel, W.S. Zaengl, J.Kuffel by Elsevier, 2nd Edition.

REFERENCES:
1. High Voltage Engineering by C.L. Wadhwa, New Age Internationals (P) Limited, 1997.
2. High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3. High Voltage Engineering, Theory and Practice by Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, Roshdy Radwan , Marcel Dekker

M. Tech – I Year – I Sem. (EPE/EPS /PSC&A)

ADVANCED DIGITAL SIGNAL PROCESSING
(Professional Elective - I)

Prerequisite: Digital Signal Processing
Course Learning Objectives
- To Comprehend characteristics of discrete time signals and systems
- To analyze and process signals using various transform techniques
- To identify various factors involved in design of digital filters
- To illustrate the effects of finite word length implementation**.**

Course Outcomes
- Analyze and process signals in the discrete domain
- Design filters to suit specific requirements for specific applications
- Perform statistical analysis and inferences on various types of signals
- Design multi rate signal processing of signals through systems.
- Analyze binary fixed point and floating-point representation of numbers and arithmetic operations

UNIT–I:
Digital Filter Structures: Block diagram representation – Equivalent Structures – FIR and IIR digital filter Structures AII pass Filters-tunable IIR Digital Sine-cosine generator- Computational complexity of digital filter structures.

UNIT–II:
Digital Filter Design: Preliminary considerations- Bilinear transformation method of IIR filter design – design of Low pass high-pass – Band-pass, and Band stop- IIR digital filters – Spectral transformations of IIR filters – FIR filter design –based on Windowed Fourier series – design of FIR digital filters with least – mean square-error – constrained Least –square design of FIR digital filters.

UNIT-III:
DSP Algorithm Implémentation : Computation of the discrete Fourier transform- Number representation – Arithmetic operations – handling of overflow – Tunable digital filters – function approximation.

UNIT-IV:
Analysis Of Finite Word Length Effects: The Quantization process and errors-Quantization of fixed –point and floating –point Numbers – Analysis of coefficient Quantization effects – Analysis of Arithmetic Round-off errors- Dynamic range scaling – signal –to- noise in Low –order IIR filters- Low – Sensitivity Digital filter – Reduction of Product round-off errors feedback – Limit cycles in IIR digital filter – Round – off errors in FFT Algorithms.

UNIT-V:
Power Spectrum Estimation: Estimation of spectra from Finite Duration Observations signals- Non-parametric methods for power spectrum Estimation- parametric method for power spectrum Estimation- Estimation of spectral form-Finite duration observation of signals- Non-parametric methods for power spectrum estimation – Walsh methods – Blackman and torchy method.

TEXT BOOKS:
1. Digital Signal Processing principles –algorithms and Applications- john G. Proakis –PHI – 3rd edition 2002.
2. Digital Time Signal Processing: Alan V. Oppenheim, Ronald W ,Shafer – PHI 1996 1st Edition reprint
3. Advanced Digital Signal Processing – Theory and Applications – Glenn Zelniker, Fred J. Taylor.

REFERENCE BOOKS
1. Digital Signal Processing – S Salivahanan. A Vallavaraj C. Gnanapriya –TMH – 2nd reprint 2001.
2. Digital Signal Processing – Sanjit K. Mitra – TMH second edition.
3. Theory and Applications of Digital Signal Processing – Lourens R Rebinarand Bernold.
4. Digital Filter Analysis and Design Auntoniam - TMH
5. Digital Signal Processing – J.S. Chitode – First Edition, 2008, Technical Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

POWER QUALITY
(Professional Elective - II)

Prerequisite: Power Systems and Power Electronics
Course Objectives
- To know different terms of power quality.
- To Illustrate of voltage power quality issue - short and long interruption
- To construct study of characterization of voltage sag magnitude and three phase unbalanced voltage sag.
- To know the behavior of power electronics loads; induction motors, synchronous motor etc by the power quality issues
- To prepare mitigation of power quality issues by the VSI converters.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Know the severity of power quality problems in distribution system;
- Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage)
- compute the concept of improving the power quality to sensitive load by various mitigating custom power devices

Unit-I:
Introduction : Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.

Unit-II:
Long & Short Interruptions: Interruptions – Definition – Difference between failures, outage, Interruptions – causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption – Overview of Reliability evaluation to power quality, comparison of observations and reliability evaluation.
Short interruptions: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions.

Unit III:
1 & 3-Phase Voltage SAG Characterization: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration.
Three phase faults, phase angle jumps, magnitude and phase angle jumps for three phase unbalanced sags, load influence on voltage sags.

Unit-IV:
Power Quality Considerations in Industrial Power Systems: Voltage sag – equipment behavior of Power electronic loads, induction motors, synchronous motors, computers, consumer electronics,

adjustable speed AC drives, and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

Unit-V:

Mitigation of Interruptions & Voltage Sags: Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events, and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.

Power Quality and EMC Standards: Introduction to standardization, IEC Electromagnetic compatibility standards, European voltage characteristics standards, PQ surveys.

TEXTBOOKS:
1. Math H J Bollen "Understanding Power Quality Problems", IEEE Press.
2. R. C. Dugan, M.F. Mc Granaghan and H. W. Beaty, "Electric Power Systems Quality." New York: McGraw-Hill. 1996

REFERENCES:
1. G. T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994).
2. Power Quality VAR Compensation in Power Systems, R. Sastry Vedam Mulukutla S. Sarma, CRC Press.
3. A Ghosh, G. Ledwich, Power Quality Enhancement Using Custom Power Devices. Kluwer Academic, 2002

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

MICROCONTROLLERS AND APPLICATIONS
(Professional Elective - II)

Prerequisite: Microprocessors and Interfacing Devices
Course Objectives:
- To relate the basic architecture and addressing modes of a microcontroller.
- To summarize the principles of top down design to microcontroller software development
- To demonstrate assembly language programs for the advanced Microcontroller , assembly language code for high-level language structures such as IF-THEN-ELSE and DO-WHILE
- To analyze a typical I/O interface and to discuss timing issues
- To identify different types of memory used in microcontroller systems

Course Outcomes: Upon the completion of the subject, the student will be able to
- Distinguish Types of computers & microcontrollers,
- Generalize 8-Bit, 16- Bit & 32 Bit advanced Microcontrollers.
- Construct Real time Applications of Microcontrollers.
- Demonstrate RTOS for Microcontrollers.
- Translate Hardware applications using Microcontrollers.

UNIT-I:
Overview of Architecture & Microcontroller Resources: Architecture of a microcontroller – Microcontroller resources – Resources in advanced and next generation microcontrollers – 8051 microcontroller – Internal and External memories – Counters and Timers – Synchronous serial-cum asynchronous serial communication - Interrupts.

UNIT-II:
8051- Microcontrollers Instruction Set : Basic assembly language programming – Data transfer instructions – Data and Bit-manipulation instructions – Arithmetic instructions – Instructions for Logical operations on the test among the Registers, Internal RAM, and SFRs – Program flow control instructions – Interrupt control flow.

UNIT-III:
Real Time Control: Interrupts: Interrupt handling structure of an MCU – Interrupt Latency and Interrupt deadline – Multiple sources of the interrupts – Non-maskable interrupt sources – Enabling or disabling of the sources – Polling to determine the interrupt source and assignment of the priorities among them – Interrupt structure in Intel 8051.
Timers: Programmable Timers in the MCU's – Free running counter and real time control – Interrupt interval and density constraints.

UNIT-IV:
Systems Design: Digital and Analog Interfacing Methods: Switch, Keypad and Keyboard interfacings – LED and Array of LEDs – Keyboard-cum-Display controller (8279) – Alphanumeric Devices – Display Systems and its interfaces – Printer interfaces – Programmable instruments interface using IEEE 488 Bus – Interfacing with the Flash Memory – Interfaces – Interfacing to High Power Devices – Analog input interfacing – Analog output interfacing – Optical motor shaft encoders – Industrial control – Industrial process control system – Prototype MCU based Measuring instruments – Robotics and Embedded control – Digital Signal Processing and digital filters.

UNIT-V:
Real Time Operating System for Microcontrollers: Real Time operating system – RTOS of Keil (RTX51) – Use of RTOS in Design – Software development tools for Microcontrollers.
16-Bit Microcontrollers: Hardware – Memory map in Intel 80196 family MCU system – IO ports – Programmable Timers and High-speed outputs and input captures – Interrupts – instructions. ARM 32 Bit MCUs: Introduction to 16/32 Bit processors – ARM architecture and organization – ARM / Thumb programming model – ARM / Thumb instruction set – Development tools.

TEXT BOOKS:
1. Raj Kamal," Microcontrollers Architecture, Programming, Interfacing and System Design"– Pearson Education, 2005.
2. Mazidi and Mazidi, "The 8051 Microcontroller and Embedded Systems" – PHI, 2000.

REFERENCES:
1. A. V. Deshmuk, "Microcontrollers (Theory & Applications)" – WTMH, 2005.
2. John B. Peatman, "Design with PIC Microcontrollers" – Pearson Education, 2005.
3. Microcontroller Programming, Julio Sanchez, Maria P. Canton, CRC Press.
4. The 8051 Microcontroller, Ayala, Cengage Learning.
5. Microprocessors and Microcontrollers, Architecture, Programming and System Design, Krishna Kant, PHI Learning PVT. Ltd.
6. Microprocessors, Nilesh B. Bahadure, PHI Learning PVT. Ltd.

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC&A)

DISTRIBUTION AUTOMATION
(Professional Elective - II)

Prerequisite: Electrical Distribution Systems
Course objectives:
- To list the distribution systems for load modeling
- To understand the design & working of substations.
- To compute system protection
- To give a comprehensive idea on communication systems.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Find the transfer of electrical data in distribution system through Digital Communication.
- Predict load forecasting and reliability in economic point of view
- Apply Distribution Automation objectives and SCADA
- To have a knowledge on management of different electrical parameters.

Unit-I:
Distribution Automation and The Utility System: Introduction to Distribution Automation (DA), control system interfaces, control and data requirements, centralized (Vs) decentralized control, DA System (DAS), DA Hardware, DAS software.

Unit-II:
Distribution Automation Functions: DA capabilities, Automation system computer facilities, management processes, Information management, system reliability management, system efficiency management, voltage management, Load management.

Unit-III:
Communication Systems for DA: DA communication requirements, Communication reliability, Cost effectiveness, Data rate Requirements, Two way capability, Ability to communicate during outages and faults, Ease of operation and maintenance, Conforming to the architecture of data flow
Communication systems used in DA : Distribution line carrier (Power line carrier), Ripple control, Zero crossing technique, telephone, cable TV, Radio, AM broadcast, FM SCA, VHF Radio, UHF Radio, Microwave satellite. Fiber optics, Hybrid Communication systems, Communication systems used in field tests.

Unit-IV:
Technical Benefits: DA benefit categories, Capital deferred savings, Operation and Maintenance savings, Interruption related savings, Customer related savings, Operational savings, improved operation, Function benefits, Potential benefits for functions, and function shared benefits, Guidelines for formulation of estimating equations Parameters required, economic impact areas, Resources for determining benefits impact on distribution system, integration of benefits into economic evaluation.

Unit-V:
Economic Evaluation Methods: Development and evaluation of alternate plans, Select study area, Select study period, Project load growth, Develop Alternatives, Calculate operating and maintenance costs, Evaluate alternatives. Economic comparison of alternate plans, Classification of expenses and capital expenditures, Comparison of revenue requirements of alternative plans, Book Life and

Continuing plant analysis, Year by year revenue requirement analysis, short term analysis, end of study adjustment, Break even analysis, Sensitivity analysis computational aids.

TEXT BOOKS:
1. Control and Automation of Electrical Distribution Systems, James. Northcote – Green Robert Wilson, CRC Press.
2. Electric Power Distribution Automation, Dr. M. K. Khedkar, Dr. G.M.Dhole, University Science press.
3. Power Distribution Automation, Biswarup Das-IET Power and Energy Series 75.

REFERENCES:
1. IEEE Tutorial Course "Distribution Automation"
2. IEEE Working Group on "Distribution Automation"

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – I SEM. (EPE/EPS/PSC & A)

POWER & ENERGY SYSTEMS LAB – I

Prerequisites: Power System Analysis, Power System Reliability, Voltage Stability
Course Objectives:
- Develop Programs for Power System Analysis.
- Design models for Power Systems and Power Electronics.
- Develop Programs of Power System Reliability and Power Electronics.

Course outcomes: Upon the completion of the lab, the student will be able to Understand/Simulate/Analyze
- Power System Analysis using Software.
- Models of Power Systems and Power Electronics.
- Programs of Power System Reliability and Power Electronics.

List of Experiments
1. Develop Program for Y_{BUS} formation.
2. Develop Program for G-S Load Flow Analysis.
3. Develop Program for N-R Load Flow Analysis.
4. Develop Program for FDLF Load Flow Analysis.
5. Develop Program for Short Circuit Analysis.
6. Develop Program for Transient Stability Analysis for Single Machine connected to Infinite Bus by Point by Point Method.
7. Develop Program for Generation System Reliability Analysis.
8. Develop Program for Distribution System Reliability Analysis.
9. Develop Simulation of RLC Circuit
10. Develop Simulation of Single Phase Full Converter with RLE Load
11. Develop Program model for Closed Loop Speed Control of Separately Excited D.C Motor.
12. Develop Program model for Sinusoidal Pulse Width Modulation.

Note: From the above list minimum 10 experiments are to be conducted using suitable software.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. I YEAR I SEMESTER

List of Open Electives Offered by Various Departments, Effective from AY 2017- 18

S. No	Name of the Department	Open Elective (S) Offered for Other Departments
1	Civil Engineering (Open Elective – I)	Computer Oriented Numerical Methods
2	Electronics and Communication Engineering (Open Elective – I)	Principles of Electronic Communications
3	Electrical and Electronics Engineering (Open Elective – I)	Renewable Energy Systems, Electrical Installation & Safety
4	Mechanical Engineering (Open Elective – I)	Optimization Techniques and Applications
5	Computer Science and Engineering (Open Elective – I)	Fundamentals of Cyber Security

CIVIL ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

COMPUTER ORIENTED NUMERICAL METHODS
(Open Elective – 1)

Course Objectives: To impart knowledge about various methods of analysing linear equations and understand the different mathematical techniques.

Course Outcomes: The learner will be able to apply various mathematical techniques to Structural engineering problems.

Unit - I:
Solutions of linear equations: Direct method – Cramer's rule, Guass – Elimination method- Gauss – Jordan elimination – Triangulation (LU Decomposition) method – Iterative methods Jacobi – Iteration method – Gauss – Siedel iteration, Successive over –relaxation method.
Eigen values and Eigen vectors: Jacobi method for symmetric matrices- Given's method for symmetric matrices-Householder's method for symmetric matrices-Rutishauser method of arbitrary matrices – Power method.

UNIT - II:
Interpolation: Linear Interpolation – Higher order Interpolation – Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation –piece-wise and spline Interpolation.

Unit - III
Finite Difference and their Applications: Introduction- Differentiation formulas by Interpolating parabolas – Backward and forward and central differences- Derivation of Differentiation formulae using Taylor series- Boundary conditions- Beam deflection – Solution of characteristic value problems- Richardson's extrapolation- Use of unevenly spaced pivotal points- Integration formulae by interpolating parabolas- Numerical solution to spatial differential equations – Applications to Simply Supported Beams, Columns and Rectangular Plates.

UNIT - IV
Numerical Differentiation: Difference methods based on undetermined coefficients- optimum choice of step length– Partial differentiation.
Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method – New Marks Method and Application to Beams – Calculation of Slopes and Deflections.

UNIT - V
Ordinary Differential Equation: Euler's method – Backward Euler method – Midpoint method – single step method, Taylor's series method- Boundary value problems.

TEXT BOOKS:
1. Numerical methods for scientific and engineering computations. M.K. Jain-S.R.K. Iyengar – R.K. Jain Willey Eastern Limited
2. Numerical Methods for Engineering Problems, N. Krishna Raju, KU Muthu, Mac-Millan publishers

REFERENCES:
1. Introductory Numerical Methods by S.S. Shastry, PHI Learning Pvt. Ltd.
2. Applied numerical analysis by – Curtis I. Gerala- Addission Wasley – published campus.
3. Numerical methods for Engineers Stevan C. Chopra, Raymond P. Canal Mc. Graw Hill Book Company.
4. C Language and Numerical methods by C. Xavier – New age international publisher.
5. Computer based numerical analysis by Dr. M. Shanta Kumar, Khanna Book publishers, New Delhi.

ELECTRONICS AND COMMUNICATION ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

PRINCIPLES OF ELECTRONIC COMMUNICATIONS
(Open Elective -1)

UNIT - I
Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT - II
Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

UNIT - III
Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony.
Networking and Local Area Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

UNIT - IV
Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.
Optical Communication: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT - V
Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, WCDMA.
Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

TEXT BOOKS
1. Louis E. Frenzel, "Principles of Electronic Communication Systems", 3rd Ed., McGraw Hill publications, 2008.
2. Kennady, Davis, "Electronic Communications systems", 4Ed., TMH, 1999

REFERENCE BOOKS
1. Tarmo Anttalainen, "Introduction to Telecommunications Network Engineering", Artech House Telecommunications Library.
2. Theodore Rappaport, "Wireless Communications-Principles and practice", Prentice Hall, 2002.
3. Roger L. Freeman, "Fundamentals of Telecommunications", 2 Ed. Wiley publications.
4. Wayne Tomasi, "Introduction to data communications and networking", Pearson Education, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

RENEWABLE ENERGY SYSTEMS
(Open Elective - I)

Course Objectives:
- To recognize the awareness of energy conservation in students
- To identify the use of renewable energy sources for electrical power generation
- To collect different energy storage methods
- To detect about environmental effects of energy conversion

Course Outcomes: Upon the completion of this course, the student will be able to
- find different renewable energy sources to produce electrical power
- estimate the use of conventional energy sources to produce electrical energy
- role-play the fact that the conventional energy resources are depleted
- arrange Store energy and to avoid the environmental pollution

Unit-I:
Photo voltaic power generation ,spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

Unit-II:
Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology.
Wind Energy conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

Unit-III:
Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.
Wave energy conversion: properties of waves and power content, vertex motion of Waves, device applications. Types of ocean thermal energy conversion systems Application of OTEC systems examples,

Unit-IV:
Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, description of fuel cells, Co-generation and energy storage, combined cycle co-generation, energy storage.
Global energy position and environmental effects: energy units, global energy position.

Unit-V:
Types of fuel cells, H_2-O_2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power. Environmental effects of energy conversion systems, pollution from coal and preventive measures steam stations and pollution, pollution free energy systems.

TEXT BOOKS:
1. "Energy conversion systems" by Rakosh das Begamudre, New age International publishers, New Delhi - 2000.

2. "Renewable Energy Resources" by John Twidell and Tony Weir, 2nd Edition, Fspon & Co.

REFERENCES:
1. "Understanding Renewable Energy Systems" by Volker Quaschning, 2005, UK.
2. "Renewable Energy Systems-Advanced Conversion, Technologies & Applications" by Faner Lin Luo Honer Ye, CRC press, Taylor & Francis group.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

ELECTRICAL INSTALLATION & SAFETY
(Open Elective - I)

Course Objectives: The course should enable the students to:
- Understand Electrical Wiring with IE rules. Residential Building Electrification, Electrification of commercial Installation, Electrification of factory unit Installation
- Protection against electric shocks, Safety Measures & Prevention of Accidents

Course Outcomes: The students will be able to:
- Acquire the knowledge of different types wires and wiring systems, I.E. rules and Electric supply act.
- Explain the importance of earthling, rating of wires & cables, procedures for residential, commercial electrification.
- Able to estimate the length of wire, cable, conduit, earth wire, and earthing and also cost of residential, commercial electrification.

Unit-I: Electrical Wiring with IE rules.
Introduction, Define types of wires; Different types of wiring system; Comparison of different types of wiring; Different types and specifications of wiring materials; Accessories and wiring tools; Prepare I.E. rules for wiring, including Electricity supply act 2003& 2005;

Unit-II : Residential Building Electrification
General rules guidelines for wiring of Residential Installation and positioning of equipment's; Principles of circuit design in lighting and power circuits.; Procedures for designing the circuits and deciding the number of circuits.; Method of drawing single line diagram.; Selection of type of wiring and rating of wires &cables.; Load calculations and selection of size of conductor.; Selection of rating of main switch, distributions board, protective switchgear ELCB and MCB and wiring accessories.; Earthing of Residential Installation.

Unit-III: Electrification of commercial Installation
Concept of commercial Installation.; Differentiate between electrification of Residential and commercial Installation.; Fundamental considerations for planning of an electrical Installation system for commercial building.; Design considerations of electrical Installation system for commercial building.; Load calculations & selection of size of service connection and nature of supply.; Deciding the size of cables, bus bar and bus bar chambers.; Mounting arrangements and positioning of switch boards, distribution boards main switch etc.; Earthing of the electrical Installation; Selection of type wire, wiring system & layout.

Unit-IV: Electrification of factory unit Installation
Concept of Industrial load; Concept of Motor wiring circuit and single line diagram. Important guidelines about power wiring and Motor wiring.; Design consideration of Electrical Installation in small Industry/Factory/workshop.; Motor current calculations.; Selection and rating of wire, cable size & conduct.; Deciding fuse rating, starter, distribution boards main switch etc.; Deciding the cable route, determination of length of wire, cable, conduit, earth wire, and earthing.

Unit-V: Protection against electric shocks
Electric shock- General , Protection against direct contact, Protection against indirect contact, Protection of goods in case of insulation fault, Implementation of the TT system, Implementation of the TN system, Implementation of the IT system. Protection provided for enclosed equipment: codes IP

and IK, IP code definition, Elements of the IP Code and their meanings, IK Code definition, IP and IK code specifications for distribution switchboards

Safety Measures & Prevention of Accidents- Concept of electrical safety, electrical accidents, its causes & preventions.; Safety signs and symbols used in industry.; Electrical shocks and factors affecting the severity of it, method of rescuing electrocuted person & different methods of artificial respiration.; Electrical safety as per I.E. Rules 1956.; Do's & don'ts regarding safety while working on electrical installations.; Concept of Permit system, its preparation & regulation for attending to electrical work.; Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers, types of fire extinguishers.

TEXT BOOKS:
1. Dr. S.L. Uppal of Electrical Wiring, Estimating and Costing, New Age International (p) Limited, New Delhi.
2. Electrical Design Estimating and Costing, K.B. Raina & S.K. Battacharya, new age international (p) limited. Publishers
3. Electrical estimating & costing 2nd addition By Surjit singh
4. Electrical Installation Estimating & Costing, Gupta, J.B., S. K. Kataria & Sons, New Delhi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech. I Year - I Sem.

OPTIMIZATION TECHNIQUES AND APPLICATIONS
(Open Elective – 1)

UNIT- I
Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, ,, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.

UNIT-II
Multi variable non-linear unconstrained optimization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT- III
Linear Programming: Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.
Simulation – Introduction – Types- steps – application – inventory – queuing systems

UNIT -IV
Integer Programming: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method
Stochastic programming:
Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming.

UNIT- V
Geometric Programming: Polynomials – arithmetic - geometric inequality – unconstrained G.P-constrained G.P (<= TYPE ONLY)
Non-traditional optimization Techniques: Genetic Algorithms-Steps-Solving simple problems-Comparitions of similarities and dissimilarities between traditional and non-traditional techniques-Particle Swarm Optimization (PSO)- Steps(Just understanding)-Simulated Annealing-Steps-Simple problems.

REFERENCES:
1. Optimization theory & Applications / S.S. Rao / New Age International.
2. Engineering Optimization-Kalyan Deb/ PHI
3. Introductory to operation Research / Kasan & Kumar / Springar
4. Optimization Techniques theory and practice / M.C.Joshi, K.M. Moudgalya/ Narosa
5. Publications
6. Operation Research / H.A. Taha /TMH
7. Optimization in operations research / R.L Rardin
8. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

FUNDAMENTALS OF CYBER SECURITY
(Open Elective - I)

Course Objective:
This course is aimed to generate interest and awareness in cyber security field, which is important in the world of information security due to the wide variety of computer crimes that take place in cyber space. The course deals with various types of attacks framed by an attacker, and the security which need to be implemented at various levels along with latest trends in cyber security.

UNIT-I:
Cyber Security Basics – Sphere, Terminology, Vulnerability in the Cyber Structure and Infrastructure, Cyber threats and Weaponry, Cyber Defense, Cyber Attack Detection and Prevention, Information Security Testing, Cyber Security Investigation/assessment, Cyber-Deterrence.

UNIT-II:
Cyber Crimes and Cyber Laws – Introduction, IT laws & Cyber Crimes – Internet, Hacking, Password Cracking, Viruses, Virus Attacks, Pornography, Software Privacy, Intellectual Property, Legal System of Information Technology, Social Engineering, Phishing, Denial of Service attack, Malicious Code, Mail Bombs, Worms, Logic Bombs, Botnet, Trojan, Bug Exploits.

UNIT-III:
End point Security: Desktop and Laptop Security, Cell Phone and PDA Security, Bluetooth Security, Patch and Vulnerability Management, Password Management, Security for Full Virtualization Technologies, Media Sanitization, Security Radio Frequency Identification (RFID) Systems. **Network Security:** Intrusion Detection & Prevention Systems, Firewalls and Firewall Policy, Computer Security Log Management, Enterprise Tele work and Remote Access Security, Securing WiMAX Wireless Communication. **Web Security:** Server Security, Web authentication, SSL and SET, Securing Public Web Servers, Secure Deployment of IPv6, Secure Domain name System (DNS) Deployment, SSL VPNs, Unified Threat Management (UTM).**;**

UNIT-IV:
Application Security: Active Content and Mobile Code, E-commerce Security, Email Security (PGP, S/MIME), Web Security, Web Application Security, OWASP; **Data Security:** Data Management, Database Security, Data Encryption, Data Leakage Prevention (DLP), Data Destruction; **Software Security:** Software Flaws, Malware, Software based Attacks; Insecurity in Software: SRE, Software Tamper Resistance, DRM, Software Development.
Operating System Security: Security Functions, Software Updates and Patches, OS Integrity Checks, Account management, Antivirus Software, Security in Ordinary Operating Systems, Design of Secure OS, OS hardening, Configuring the OS for security, Security kernels, Secure Virtual machine Systems, Trusted Operating System, NGSCB.

UNIT-V:
Recent Trends in Cyber Security – Zero – day Malware, Trojan Wars, New Ways to Monetize Non-Financial Data, Fraud-as-a-service, Out-of-band Methods forcing Cybercriminals to Innovate, The Rise of Hactivism, Attacks in mobile devices, social media and cloud computing; Insider threats, Increased regulatory security, Cyber-Terrorism, Cyber –War and Cyber-Peace. Topological Vulnerability Analysis, Cyber Situational Awareness, Secure Composition of Systems, Autonomic Recovery, Secure Data Centers, Cloud Computing Security, Privacy in location-Based Applications.

TEXT BOOKS:
1. Cyber Security, Edward Amoroso, kindle Edition, 2007
2. Cyber Security ,Understanding Cyber crimes, Computer Forensics and Legal Perspectives, Sunita Belapure and Nina Godbole, Wiley India Pvt Ltd. 2011

REFERENCES:
1. Computer Security, Dirter Gollmann, John Wiley & Sons Publication, 2011
2. Cyber Security Essentials, James Graham, Richard Howrad, Ryan Olson, CRC Press, 2011

POWER SYSTEM DYNAMICS AND CONTROL (Professional Core - IV)

Prerequisite: Computer Methods in Power Systems
Course objectives:
- To remember the dynamic characteristics of power system equipment,
- To recognize dynamic performance of power systems
- To illustrate the system stability and controls.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Choose the fundamental dynamic behavior and controls of power systems to perform basic stability analysis.
- Comprehend concepts in modeling and simulating the dynamic phenomena of power systems Interpret results of system stability studies
- Analyze theory and practice of modeling main power system components, such as synchronous machines, excitation systems and governors

UNIT- I:
Basic Concepts: Power system stability states of operation and system security - system dynamics - problems system model analysis of steady State stability and transient stability - simplified representation of Excitation control.

UNIT- II:
Modeling of Synchronous Machine: Synchronous machine - park's Transformation-analysis of steady state performance per - unit quantities-Equivalent circuits of synchronous machine-determination of parameters of equivalent circuits.

UNIT- III:
Excitation System: Excitation system modeling-excitation systems block Diagram - system representation by state equations- Dynamics of a synchronous generator connected to infinite bus - system model Synchronous machine model-stator equations rotor equations - Synchronous machine model with field circuit - one equivalent damper winding on q axis (model 1.1) - calculation of Initial conditions.

UNIT- IV:
Analysis of Single Machine System: Small signal analysis with block diagram - Representation Characteristic equation and application of Routh Hurwitz criterion- synchronizing and damping torque analysis-small signal model - State equations.

UNIT - V:
Application of Power System Stabilizers: Basic concepts in applying PSS - Control signals - Structure and tuning of PSS - Washout circuit - Dynamic compensator analysis of single machine infinite bus system with and without PSS.

TEXT BOOKS:
1. K. R. PADIYAR," Power system dynamics "- B.S. Publications.
2. P.M. Anderson and A. A. Fouad, "Power system control and stability", IEEE Press

REFERENCE:
1. R. Ramanujam, "Power Systems Dynamics"- PHI Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/ PSC&A)

FLEXIBLE AC TRANSMISSION SYSTEMS (FACTS) (Professional Core - V)

Prerequisite: Power Electronics and Power Systems-II

Course Objectives:
- To understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits
- To recall the oobjectives of Shunt and Series compensation
- To explain ccontrol of STATCOM and SVC and their comparison And the regulation of STATCOM
- To analyze the functioning and control of GCSC, TSSC and TCSC

Course Outcomes: Upon the completion of the subject, the student will be able to
- Choose proper controller for the specific application based on system requirements
- Understand various systems thoroughly and their requirements
- Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
- Detect the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

UNIT - I:
Facts Concepts: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits from FACTS controllers.

UNIT - II:
Voltage Source Converters : Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT - III:
Static Shunt Compensation: Objectives of shunt compensation, mid-point voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable VAR generation, variable impedance type static VAR generators switching converter type VAR generators hybrid VAR generators.

UNIT - IV:
SVC And STATCOM: The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT - V:
Static Series Compensators: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, and functional requirements of GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), Control schemes for GSC TSSC and TCSC.

TEXT BOOKS:
1. Hingorani H G and Gyugyi. L "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems" New York, IEEE Press, 2000.
2. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007

REFERENCES:
1. Zhang, Xiao-Ping, Rehtanz, Christian, Pal, Bikash "Flexible AC Transmission Systems: Modeling and Control", Springer, 2012
2. Yong-Hua Song, Allan Johns, "Flexible AC Transmission Systems", IET,1999

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/ PSC&A)

POWER SYSTEM OPERATION AND DEREGULATION (Professional Core - VI)

Prerequisite: Power System Operation and Control

Course objectives:
- To find OPF with security constraints.
- To generalize modeling of load frequency control of a power system
- To compute reactive power control of a power system.
- To apply the concept of deregulation and ATC.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Know the optimal scheduling of power plants
- Outline the modeling of turbine and generator
- Compute the steady state behavior of the power system for voltage and frequency fluctuations.
- Analyze ATC and the cost of transmission

UNIT- I:
Optimal Power Flow: Introduction- Solution to the optimal power flow-gradient method-Newton's method-Linear sensitivity analysis- Linear programming methods- Security constrained OPF-Interior point algorithm- Bus incremental costs

UNIT- II:
Power System Security: Introduction –Factors affecting power system security-Contingency analysis-Detection of network problems-Linear sensitivity analysis-AC power flow methods-contingency selection-concentric relaxation-Bounding area method

UNIT- III:
State Estimation in Power Systems: Introduction- Power system state estimation- Maximum likelihood Weighted Least squares estimation-Matrix formulation- State estimation of AC network-State estimation by orthogonal decomposition- detection and identification of Bad measurements-Estimation of quantities not being measured- Network observability and pseudo measurements

UNIT- IV:
Power System Deregulation: Introduction- motivation for restructuring of power systems- Electricity market entities model-benefits of deregulation- terminology-deregulation in Indian power sector-Operations in power markets-power pools-transmission networks and electricity markets.

UNIT-V:
Available Transfer Capability: Introduction methods: of determination of ATC - ATC calculation considering the effect of contingency analysis- Transmission open access and pricing-cost components of transmission system- transmission pricing methods-Incremental cost based transmission pricing.

TEXT BOOKS:
1. J. Wood & B.F. Woollenberg- John Wiley Power Generation, "Operation and Control"-2nd edition.
2. P. Venkatesh. B. V. Manikandan, S. Charles Raja- A. Srinivasan, "Electrical power systems:

Analysis, security, Deregulation"– PHI 2012

REFERENCES:
1. Bhattacharya, Kankar, Bollen, Math, Daalder, Jaap E. "Operation of Restructured Power System", 2001, Springer.
2. Venkatesh P. , Manikandan B. V., Raja S. Charles , Srinivasan A. Electrical Power Systems: Analysis, Security And Deregulation, Phi Learning Pvt Ltd

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/PSC&A)

GAS INSULATED SYSTEMS (GIS)
(Professional Elective – III)

Prerequisite: Switch Gear and Protection

Course objectives:
- To know the GIS concepts and principles
- To choose Air Insulated Substation and GIS
- To demonstrate the design and constructional aspects of GIS
- Toanalyzetransient phenomenon, problems and diagnostic methods in GIS

Course Outcomes: Upon the completion of the subject, the student will be able to
- Know the advantages of GIS systems over air insulated systems
- Observe constructional design features of GIS design
- Discriminate the Problems and design diagnostic methods of GIS

UNIT – I:
Introduction to GIS and Properties Of Sf_6
Characteristics of GIS- Introduction to SF_6 - Physical properties-Chemical properties - Electrical properties-Specification of SF_6 gas for GIS application - Handling of SF_6 gas before use - Safe handling of Sf_6 gas in electrical equipment - Equipment for handling the SF_6 Gas - SF_6 and environment.

UNIT – II:
Layout of GIS Stations: Advancement of GIS station - Comparison with Air Insulated Substation - Economics of GIS - User Requirements for GIS - Main Features for GIS - Planning and Installation components of a GIS station.

UNIT – III:
Design and Construction of GIS Station: Introduction - Rating of GIS components - Design Features - Estimation of different types of Electrical Stresses -Design Aspects of GIS components - Insulation Design for Components - Insulation Design for GIS - Thermal Considerations in the Design of GIS - Effect of very Fast Transient Over-voltages (VFTO) on the GIS design - Insulation Coordination systems - Gas handling and Monitoring System Design.

UNIT - IV:
Fast Transient Phenomena in GIS: Introduction- Disconnector Switching in Relation to Very fast Transients-Origin of VFTO-Propagation and Mechanism of VFTO-VFTO Characteristics- Effects of VFTO-Testing of GIS for VFTO.

UNIT – V:
Special Problems in GIS and GIS Diagnostics: Introduction - particles their effects and their control- Insulating Spacers and their Reliability - SF_6 Gas Decomposition - Characteristics of imperfections in insulation - Insulation Diagnostic methods - PD Measurement and UHF Method.

TEXT BOOKS:
1. M. S. Naidu," Gas Insulated Substations"- IK International Publishing House.
2. Hermann J. Koch, "Gas Insulated Substations", June 2014, Wiley-IEEE Press

REFERENCES:

1. Olivier Gallot - Lavellee, "Dielectric materials and Electrostatics" , Wiley-IEEE Press
2. Jaun Martinez, "Dielectric Materials for Electrical Engineering", Wiley-IEEE Press

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/PSC&A)

PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS
(Professional Elective – III)

Course Objectives
- It is to provide and ensure a comprehensive understanding of using advanced controllers in measurement and control instrumentation.
- To illustrate about data acquisition - process of collecting information from field instruments.
- To analyze Programmable Logic Controller (PLC), IO Modules and internal features.
- To Comprehend Programming in Ladder Logic, addressing of IO.
- To apply PID and its Tunning.

Course Outcomes
- Describe the main functional units in a PLC and be able to explain how they interact.
- They should know different bus types used in automation industries.
- Development of ladder logic programming for simple process.
- At the end of each chapter, review question, problems given to reinforce their understanding of the concepts.

UNIT - I:
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT - II:
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation.
Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT - III:
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT - IV:
Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT - V:
Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

TEXT BOOKS:
1. Programmable Logic Controllers – Principle and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI

2. Digital Design by Morris Mano, PHI, 3rd Edition 2006.

REFERENCE BOOKS:
1. Programmable logic Controllers, Frank D. Petruzella, 4th Edition, McGraw Hill Publishers.
2. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth & F.D Hackworth Jr. – Pearson, 2004.
3. Programmable logic controllers and their Engineering Applications, 2nd Edition, Alan J. Crispin.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/ PSC&A)

ENERGY AUDITING CONSERVATION AND MANAGEMENT
(Professional Elective – III)

Course Objectives:
- To know the necessity of conservation of energy
- To generalize the methods of energy management
- To illustrate the factors to increase the efficiency of electrical equipment
- To detect the benefits of carrying out energy audits.

Course Outcomes: Upon the completion of this course, the student will be able to
- Tell energy audit of industries
- Predict management of energy systems
- Sequence the methods of improving efficiency of electric motor
- Analyze the power factor and to design a good illumination system
- Determine pay back periods for energy saving equipment

UNIT- I:
Basic Principles of Energy Audit: Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT- II:
Energy Management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities, and functions, language, Questionnaire – check list for top management.

UNIT- III:
Energy Efficient Motors: Energy efficient motors, factors affecting efficiency, loss distribution, constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

UNIT- IV:
Power Factor Improvement, Lighting and Energy Instruments: Power factor – methods of improvement, location of capacitors, pf with non linear loads, effect of harmonics on power factor, power factor motor controllers - Good lighting system design and practice, lighting control, lighting energy audit - Energy Instruments- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

UNIT- V:
Economic Aspects and Analysis: Economics Analysis-Depreciation Methods, time value of money, rate of return , present worth method , replacement analysis, life cycle costing analysis- Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting - Applications of life cycle costing analysis, return on investment .

TEXT BOOKS:
1. Energy management by W.R. Murphy AND G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998

REFERENCES:

1. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995
2. Energy management hand book by W. C. Turner, John wiley and sons
3. Energy management and good lighting practice : fuel efficiency- booklet 12- EEO

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/ PSC&A)

REACTIVE POWER COMPENSATION AND MANAGEMENT
(Professional Elective – IV)

Prerequisite: Power Systems - II

Course Objectives:
- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To contrast reactive power coordination system
- To characterize distribution side and utility side reactive power management.

Course Outcomes: Upon the completion of the subject, the student will be able to
- Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads
- Observe various compensation methods in transmission lines
- Construct model for reactive power coordination
- Distinguish demand side reactive power management & user side reactive power management

UNIT - I:
Load Compensation: Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT - II:
Steady – State Reactive Power Compensation in Transmission System: Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples
Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples

UNIT - III:
Reactive Power Coordination: Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences

UNIT - IV:
Demand Side Management: Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels
Distribution side Reactive power Management:: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

UNIT - V:

User Side Reactive Power Management: KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

TEXT BOOKS:

1. Reactive power control in Electric power systems by T. J. E. Miller, John Wiley and sons, 1982.
2. Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004.

REFERENCES:

1. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April, 2012, Wiely publication.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS /PSC&A)

POWER SYSTEM RELIABILITY
(Professional Elective – IV)

Prerequisite: Reliability Engineering

Course Objectives:
- To identify the generation system model and recursive relation for capacitive model building
- To calculate the equivalent transitional rates, cumulative probability and cumulative frequency
- To classify the risk, system and load point reliability indices
- To evaluate the basic reliability indices

Course Outcomes: Upon the completion of the subject, the student will be able to
- Find loss of load and energy indices for generation systems model
- Describe merging generation and load models
- Apply various indices for distribution systems

UNIT- I:
Generating System Reliability Analysis – I: Generation system model – capacity outage probability tables – Recursive relation for capacitive model building – sequential addition method – unit removal – Evaluation of loss of load and energy indices – Examples.

UNIT- II:
Generating System Reliability Analysis – II: Frequency and Duration methods – Evaluation of equivalent transitional rates of identical and non-identical units – Evaluation of cumulative probability and cumulative frequency of non-identical generating units – 2- level daily load representation - merging generation and load models – Examples.

UNIT- III
Operating Reserve Evaluation: Basic concepts - risk indices – PJM methods – security function approach – rapid start and hot reserve units – Modelling using STPM approach.
Bulk Power System Reliability Evaluation: Basic configuration – conditional probability approach – system and load point reliability indices – weather effects on transmission lines – Weighted average rate and Markov model – Common mode failures.

UNIT- IV:
Inter Connected System Reliability Analysis: Probability array method – Two inter connected systems with independent loads – effects of limited and unlimited tie capacity - imperfect tie – Two connected Systems with correlated loads – Expression for cumulative probability and cumulative frequency.
Distribution System Reliability Analysis – I (Radial configuration): Basic Techniques – Radial networks –Evaluation of Basic reliability indices, performance indices – load point and system reliability indices – customer oriented, loss and energy oriented indices – Examples.

UNIT - V:
Distribution System Reliability Analysis - II (Parallel Configuration): Basic techniques – inclusion of bus bar failures, scheduled maintenance – temporary and transient failures – weather effects – common mode failures –Evaluation of various indices – Examples

Substations and Switching Stations: Effects of short-circuits - breaker operation – Open and Short-circuit failures – Active and Passive failures – switching after faults – circuit breaker model – preventive maintenance – exponential maintenance times.

TEXT BOOKS:

1. Reliability Evaluation of Power systems by R. Billinton, R. N. Allan, BS Publications, 2007.
2. Reliability Modeling in Electric Power Systems by J. Endrenyi, John Wiley and Sons, 1978

REFERENCES:

1. Reliability Engineering: Theory and Practice by Alessandro Birolini, Springer Publications.
2. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, TMH Publications.
3. Reliability Engineering by E. Balaguruswamy, TMH Publications.
4. Reliability Engineering by Elsayed A. Elsayed, Prentice Hall Publications.

VOLTAGE STABILITY (Professional Elective – IV)

Prerequisite: Computers Methods in Power Systems
Course Objectives:
- To choose SEC Planning and Operational Standards of Security
- To estimate Reactive Power Control in Generation/Transmission Interconnected Networks
- To apply sstability/Instability in Generation/Transmission Interconnected Networks
- To analyze design and Operational Solutions
- To characterize voltage Control in Distribution Networks

Course Outcomes: Upon the completion of the subject, the student will be able to
- Understand issues related to power system stability and control.
- Demonstrate various load models in voltage stability analysis.
- Detect reactive power compensation techniques & their practical importance

UNIT – I:
Introduction to Voltage Stability: Definitions: Voltage Stability, Voltage Collapse, Voltage Security; Physical relation indicating dependency of voltage on reactive power flow; Factors affecting Voltage collapse and instability; Previous cases of voltage collapse incidences.

UNIT – II:
Graphical Analysis of Voltage Stability: Comparison of Voltage and angular stability of the system; Graphical Methods describing voltage collapse phenomenon: P-V and Q-V curves; detailed description of voltage collapse phenomenon with the help of Q-V curves.

UNIT – III:
Analysis of Voltage Stability: Analysis of voltage stability on SMLB system: Analytical treatment and analysis.
Voltage Stability Indices: Voltage collapse proximity indicator; Determinant of Jacobin as proximity indicators; Voltage stability margin.

UNIT – IV:
Power System Loads: Loads that influences voltage stability: Discharge lights, Induction Motor, Air-conditioning, heat pumps, electronic power supplies, OH lines and cables.
Reactive Power Compensation: Generation and Absorption of reactive power; Series and Shunt compensation; Synchronous condensers, SVC s; OLTC s; Booster Transformers.

UNIT–V:
Voltage Stability Margin: Stability Margin: Compensated and un-compensated systems.
Voltage Security: Definition; Voltage security; Methods to improve voltage stability and its practical aspects.

TEXT BOOKS:
1. "Performance, operation and control of EHV power transmission system"-A. CHAKRABARTHY, D. P. KOTARI and A. K. MUKOPADYAY, A. H. Wheeler Publishing, I Edition, 1995.
2. "Power System Dynamics: Stability and Control" – K. R. PADIYAR, II Edition, B. S. Publications.

REFERENCES:
1. "Power System Voltage Stability"- C. W. TAYLOR, McGraw Hill, 1994.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH – I YEAR – II SEM. (EPE/EPS/ PSC&A)

POWER AND ENERGY SYSTEMS LAB – II

Prerequisites: Power System Analysis, Power System Protection

Course Objectives:
- To understand the Performance of Transformers and Synchronous Machines
- To select the Transmission Lines, UG Cables, String Insulators, CTs and PTs.
- To analyze the characteristics of OC, UV/OV, negative sequence relays.

Course Outcomes: Upon the completion of the lab, the student will be able to
- Test and evaluate the performance of Power Transformers and Synchronous Machines.
- Test and evaluate the performance of Transmission lines, UG Cables, Insulators and other Auxiliary Power Systems Equipment
- Test, Evaluate/Choose the various types of Relays (Electromagnetic, Static and Microprocessor based relays)

1. Determination of Equivalent circuit of a 3-Winding Transformer.
2. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine.
3. Fault Analysis:
     i. Single Line to Ground fault (L-G).
     ii. Line to Line fault (L-L).
     iii. Double Line to Ground fault (L-L-G).
     iv. Triple Line to Ground fault (L-L-L-G).
4. Determination of Sub-transient reactance's of a Salient Pole Synchronous Machine.
5. Determination of Sequence Impedances of Three Phase Transformer
6. Characteristics of Over Current Relays
     i. IDMT Electromagnetic Relay   (7051 A).
     ii. Microprocessor based Relay (7051 B)
7. Characteristics of Percentage biased Differential Relay.
     i. Electromagnetic Relay (7054 A).
     ii. Static Relay (7054 B).
8. Characteristics of Over Voltage Relay.
     I. Electromagnetic Relay (7053 A).
     II. Microprocessor based Relay (7053 B).
9. Characteristics of Under Voltage (UV) and Negative sequence Relays
     i. Uv Electromagnetic Relay (7052 A).
     ii. Uv Microprocessor Based Relay (7052 B).
     iii. Static Negative Sequence Relay (7055 B).
10. Performance and Testing of Generator Protection System.
11. Performance and Testing of Transformer Protection System.
12. Performance and Testing of Feeder Protection System.
13. Performance and Testing of Transmission Line Model.
14. Differential protection on Single Phase Transformer.

Note: From the above list minimum 10 experiments are to be conducted

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. TECH. I YEAR II SEMESTER

List of Open Electives Offered by Various Departments, Effective from AY 2017 - 18

S. No	Name of the Department	Open Elective (S) Offered for Other Departments
1	Civil Engineering (Open Elective – II)	1. Finite Element Method 2. Optimization Techniques
2	Electronics and Communication Engineering (Open Elective – II)	1. Industrial Instrumentation 2. Principles of Computer Communications and Networks
3	Electrical and Electronics Engineering (Open Elective – II)	1. Energy From Waste 2. Distributed Generation and Microgrid 3. Reliability Engineering
4	Mechanical Engineering (Open Elective – II)	1. Engineering Research Methodology
5	Computer Science and Engineering (Open Elective – II)	1. Machine Learning

*Open Elective subject must be chosen from the list of open electives offered by OTHER departments.

Ex: A M.Tech ECE student cannot take Open Elective – II offered by ECE Dept, but can select from open electives offered by OTHER departments.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

FINITE ELEMENT METHOD (Open Elective – II)

Course Objectives: To impart knowledge about various finite element techniques and development of finite element code.

Course Outcome: The learner will be able to solve continuum problems using finite element analysis.

UNIT - I
Introduction: Concepts of FEM - steps involved - merits and demerits - energy principles –
Discretization - Raleigh - Ritz method of functional approximation.
Principles of Elasticity: Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT - II
One dimensional FEM:Stiffness matrix for beam and bar elements - shape functions for 1-D elements.
Two dimensional FEM: Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions - convergent and compatibility requirements - geometric invariance - natural coordinate system - area and volume coordinates - generation of element stiffness and nodal load matrices

UNIT - III
Isoparametric formulation:Concept - different isoparametric elements for 2D analysis -formulation of 4-noded and 8-noded isoparametric quadrilateral elements - Lagrange elements - serendipity elements.
Axi Symmetric Analysis:bodies of revolution - axi symmetric modeling - strain displacement relationship - formulation of axi symmetric elements.
Three dimensional FEM:Different 3-D elements-strain-displacement relationship –formulation of hexahedral and isoparametric solid element.

UNIT - IV
Introduction to Finite Element Analysis of Plates:Basic theory of plate bending - thin plate theory - stress resultants - Mindlin's approximations - formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

UNIT - V
Introduction to non – linear finite analysis – basic methods – application to Special structures.

TEXT BOOKS:
1. A First Course in a Finite Element by Daryl L .Logan, CL Engineers.
2. Concepts and Applications of Finite Element Analysis by Robert D.Cook, DavidS. Malkus and Michael E. Plesha, John Wiley & Sons.

REFERENCES:
1. Introduction to Finite element Method by Tirupathi Chandra Patla and Belugunudu
2. Finite element Methods by OC Zienkiewicz
3. Finite element analysis, theory and progarmming by GS Krishna Murthy.
4. Introduction to Finite element Method by JN Reddy.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

OPTIMIZATION TECHNIQUES (Open Elective – II)

Course Objectives: To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems

Course Outcomes: The student will be able to understand the basic principles of optimization, and in a position to formulate optimization models for a wide range of civil engineering problems and able to solve them.

Unit-I
Linear Programming: Introduction and need for optimization in engineering design, formulating linear programs, graphical solution of linear programs, special cases of linear programming.

UNIT - II
The Simplex Method: Converting a problem to standard form, the theory of the simplex method, the simplex algorithm, special situations in the simplex algorithm, obtaining initial feasible solution.

UNIT - III
Duality and Sensitivity Analysis: Sensitivity analysis, shadow prices, dual of a normal linear program, duality theorems, dual simplex method. Integer Programming: Formulating integer programming problems, the branch-and-bound algorithm for pure integer programs, the branch-and-bound algorithm for mixed integer programs.

UNIT - IV
Non-linear Programming: Introduction to non-linear programming (NLP), Convex and concave functions, NLP with one variable, Line search algorithms, Multivariable unconstrained problems, constrained problems, Lagrange Multiplier, The Karush-Kuhn-Tucker (KKT) conditions, the method of steepest ascent, convex combination method, penalty function, Quadratic programming,

UNIT - V
Dynamic programming: Evolutionary algorithms: Genetic Algorithm, concepts of multiobjective optimization, Markov Process, Queuing Models.

TEXT BOOK:
1. S.S. Rao, Engineering Optimization: Theory and Practice, Wiley & Sons, New Jersey, 2009.

REFERENCES:
1. F.H. Hiller and G.J. Liberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010.
2. W.L. Winston, Operations Research: Applications and Algorithm, 4th Edition, Cengage Learning, 1994.
3. K.Deb, Optimization for Engineering Design, Prentice Hall, 2013.
4. M.C. Joshi and K.M. Moudgalay, Optimization: Theory and Practice, Narosa, 2004.
5. K. Deb, Multi-Objective Optimization using evolutionary algorithms, John Wiley and Sons, 2009.

ELECTRONICS AND COMMUNICATION ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

INDUSTRIAL INSTRUMENTATION (Open Elective – II)

UNIT - I
METROLOGY, VELOCITY AND ACCELERATION MEASUREMENT: Measurement of length - Gauge blocks – Plainness – Area using Simpson's rule, Plain meter – Diameter – Roughness – Angle using Bevel protractor, sine bars and Clinometer – Mechanical, Electrical, Optical and Pneumatic Comparators. Optical Methods for length and distance measurements using Optical flats and Michelson Interferometer.
Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers - Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers-different types, Gyroscopes-applications.

UNIT - II
FORCE AND PRESSURE MEASUREMENT: Force measurement – Different methods –Gyroscopic Force Measurement – Vibrating wire Force transducer. Basics of Pressure measurement –Manometer types – Force-Balance and Vibrating Cylinder Transducers – High and Low Pressure measurement – McLeod Gauge, Knudsen Gauge, Momentum Transfer Gauge, Thermal Conductivity Gauge, Ionization Gauge, Dual Gauge Techniques, Deadweight Gauges, Hydrostatic Pressure Measurement

UNIT - III
FLOW MEASUREMENT AND LEVEL MEASUREMENT: Flow Meters- Head type, Area type (Rota meter), electromagnetic type, Positive displacement type, mass flow meter, ultrasonic type, vertex shedding type, Hotwire anemometer type, Laser Doppler Velocity-meter. Basic Level measurements – Direct, Indirect, Pressure, Buoyancy, Weight, Capacitive Probe methods

UNIT - IV
DENSITY, VISCOSITY AND OTHER MEASUREMENTS: Density measurements – Strain Gauge load cell method – Buoyancy method - Air pressure balance method – Gamma ray method – Vibrating probe method. Units of Viscosity, specific gravity scales used in Petroleum Industries, Different Methods of measuring consistency and Viscosity –Two float viscorator –Industrial consistency meter. Sound-Level Meters, Microphones, Humidity Measurement

UNIT - V
CALIBRATION AND INTERFACING: Calibration using Master Sensors, Interfacing of Force, Pressure, Velocity, Acceleration, Flow, Density and Viscosity Sensors, Variable Frequency Drive

TEXT BOOKS:
1. Doeblin E.O., "Measurement Systems – Applications and Design", 4th Edition, McGraw Hill International, 1990.
2. Patranabis D, "Principles of Industrial Instrumentation", TMH. End edition 1997

REFERENCES:
1. Considine D. M., "Process Instruments and Control Handbook", 4th Edition, McGraw Hill International, 1993
2. Jain R.K., "Mechanical and Industrial Measurements", Khanna Publications.

ELECTRONICS AND COMMUNICATION ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS (Open Elective – II)

Prerequisite: Nil

Course Objectives:
- To understand the concept of computer communication.
- To learn about the networking concept, layered protocols.
- To understand various communications concepts.
- To get the knowledge of various networking equipment.

Course Outcomes: The student:
- Can get the knowledge of networking of computers, data transmission between computers.
- Will have the exposure about the various communication concepts.
- Will get awareness about the structure and equipment of computer network structures.

UNIT - I
Overview of Computer Communications and Networking: Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

UNIT - II
Essential Terms and Concepts: Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

UNIT - III
Analog and Digital Communication Concepts: Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction , Digital Carrier Systems.

UNIT - IV
Physical and data link layer Concepts: The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.

UNIT - V
Network Hardware Components: Introduction to Connectors, Transreceivers and media convertors, repeaters, network interference cards and PC cards, bridges, switches, switches Vs Routers.

TEXT BOOKS:
1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.

REFERENCE BOOKS:
1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.

ELECTRICAL AND ELECTRONICS ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

ENERGY FROM WASTE (Open Elective – II)

Prerequisite: Renewable Energy Sources, Physics, Environmental Studies

Course Objectives:
- To classify solid waste sources
- To identify methods of solid waste disposal
- To study various energy generation methods
- To analyse biogas production methods and recycling of e-waste

Course Outcomes: Upon the completion of the subject, the student will be able to
- Understand technologies for generation of energy from solid waste
- Compare methods of solid waste disposal
- Identify sources of energy from bio-chemical conversion
- Analyze methods for management of e-waste

UNIT- I
Solid Waste Sources Solid Waste Sources, types, composition, Properties, Global warming, Municipal Solid Waste: Physical, chemical and biological properties , Waste Collection and, Transfer stations, Waste minimization and recycling of municipal waste, Segregation of waste, Size Reduction , Managing Waste. Status of technologies for generation of Energy from Waste Treatment and Disposal Aerobic composting, incineration, Furnace type and design, Medical waste /Pharmaceutical waste treatment Technologies, incineration, Environmental impacts, Measures to mitigate environmental effects due to incineration .

UNIT - II
Land Fill method of Solid waste disposal Land fill classification, Types, methods and Sitting consideration, Layout and preliminary design of landfills: Composition, characteristics, generation, Movement and control of landfill leach ate and gases, Environmental monitoring system for land fill gases.

UNIT - III
Energy Generation from Waste Bio-chemical Conversion: Sources of energy generation, anaerobic digestion of sewage and municipal wastes, direct combustion of MSW-refuse derived solid fuel, Industrial waste, agro residues, Anaerobic Digestion.

UNIT - IV
Biogas production, Land fill gas generation and utilization, Thermo-chemical conversion: Sources of energy generation, Gasification of waste using Gasifiers, Briquetting, Utilization and advantages of briquetting, Environmental benefits of Bio-chemical and Thermo- chemical conversion.

UNIT - V
E-waste: e-waste in the global context – Growth of Electrical and Electronics Industry in India – Environmental concerns and health hazards – Recycling e-waste: a thriving economy of the unorganized sector – Global trade in hazardous waste – impact of hazardous e-waste in India. Management of e-waste: e-waste legislation, Government regulations on e-waste management – International experience – need for stringent health safeguards and environmental protection laws of India.

TEXT BOOKS:
1. Nicholas P. Cheremisinoff. Handbook of Solid Waste Management and Waste Minimization Technologies. An Imprint of Elsevier, New Delhi (2003).
2. P. Aarne Vesilind, William A. Worrell and Debra R. Reinhart. Solid Waste Engineering. Thomson Asia Pte Ltd. Singapore (2002)
3. M. Dutta , B. P. Parida, B. K. Guha and T. R. Surkrishnan. Industrial Solid Waste Management and Landfilling practice. Narosa Publishing House, New Delhi (1999).

4. "E-waste in India: Research unit, Rajya Sabha Secretariat, New Delhi, June 2011"
5. Amalendu Bagchi. Design, construction and Monitoring of Landfills. John Wiley and Sons. New York. (1994)
6. M. L. Davis and D. A. Cornwell. Introduction to environmental engineering. Mc Graw Hill International Edition, Singapore (2008)
7. C. S. Rao. Environmental Pollution Control Engineering. Wiley Eastern Ltd. New Delhi (1995)
8. S. K. Agarwal. Industrial Environment Assessment and Strategy. APH Publishing Corporation. New Delhi (!996)
9. Sofer, Samir S. (ed.), Zaborsky, R. (ed.), "Biomass Conversion Processes for Energy and Fuels", New York, Plenum Press, 1981
10. Hagerty, D.Joseph; Pavoni, Joseph L; Heer, John E., "Solid Waste Management", New York, Van Nostrand, 1973
11. George Tchobanoglous, Hilary Theisen and Samuel Vigil Prsl: Tchobanoglous, George Theisen, Hillary Vigil, Samuel, "Integrated Solid Waste management: Engineering Principles and Management issues", New York, McGraw Hill, 1993.

REFERENCES:
1. C Parker and T Roberts (Ed), Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
2. KL Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, 2000 3. M Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
3. G Rich et.al, Hazardous Waste Management Technology, Podvan Publishers, 1987
4. AD Bhide, BB Sundaresan, Solid Waste Management in Developing Countries, INSDOC, New Delhi,1983 FUEL CELL AND
5. **Google books:**
   (i) e-waste Management: From waste to Resource Klaus Hieronymi, Ramzy Kahnat, Eric williams
      Tech. & Engg.-2013(Publisher: Earthscan 2013).
   (ii) What is the impact of E-waste: Tamara Thompson
   (iii) E-waste poses a Health Hazard: Sairudeen Pattazhy
6. **Weblinks :**
   www.unep.org
   www.routledge.com
   www.amazon.com
   www.bookdepository.com
   www.ecoactiv.com

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

DISTRIBUTED GENERATION AND MICROGRID (Open Elective – II)

Course Objectives
- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Micro grid and its configuration
- To find optimal size, placement and control aspects of DGs

Course Outcomes: Upon the Completion of the course student will be able to
- Find the size and optimal placement DG
- Analyze the impact of grid integration and control aspects of DGs
- Model and analyze a micro grid taking into consideration the planning and operational issues of the DGs to be connected in the system
- Describe the technical impacts of DGs in power systems

UNIT - I
Need for distributed generation - Renewable sources in distributed generation - Current scenario in distributed generation - Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT - II
Grid integration of DGs – Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Energy storage elements - Batteries, ultra-capacitors, flywheels.

UNIT - III
Technical impacts of DGs – Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT-IV
Economic and control aspects of DGs – Market facts, issues and challenges - Limitations of DGs - Voltage control techniques, Reactive power control, Harmonics, Power quality issues - Reliability of DG based systems – Steady state and Dynamic analysis.

UNIT - V
Introduction to micro-grids – Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids - Modeling & analysis - Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units - Transients in micro-grids - Protection of micro-grids – Case studies.

TEXT BOOKS:
1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
3. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
4. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
5. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

RELIABILITY ENGINEERING (Open Elective – II)

Course Objectives:
- To comprehend the concept of Reliability and Unreliability
- Derive the expressions for probability of failure, Expected value and standard deviation of Binominal distribution, Poisson distribution, normal distribution and weibull distributions.
- Formulating expressions for Reliability analysis of series-parallel and Non-series parallel systems
- Deriving expressions for Time dependent and Limiting State Probabilities using Markov models.

Course Outcomes: Upon the completion of this course, the student will be able to
- Apply fundamental knowledge of Reliability to modeling and analysis of series-parallel and Non-series parallel systems.
- Solve some practical problems related with Generation, Transmission and Utilization of Electrical Energy.
- Understand or become aware of various failures, causes of failures and remedies for failures in practical systems.

UNIT – I
Rules for combining probabilities of events, Definition of Reliability. Significance of the terms appearing in the definition. Probability distributions: Random variables, probability density and distribution functions. Mathematical expectation, Binominal distribution, Poisson distribution, normal distribution, weibull distribution.

UNIT - II
Hazard rate, derivation of the reliability function in terms of the hazard rate. Failures: Causes of failures, types of failures (early failures, chance failures and wear-out failures). Bath tub curve. Preventive and corrective maintenance. Modes of failure. Measures of reliability: mean time to failure and mean time between failures.

UNIT - III
Classification of engineering systems: series, parallel and series-parallel systems- Expressions for the reliability of the basic configurations.
Reliability evaluation of Non-series-parallel configurations: Decomposition, Path based and cutest based methods, Deduction of the Paths and cutsets from Event tree.

UNIT - IV
Discrete Markov Chains: General modeling concepts, stochastic transitional probability matrix, time dependent probability evaluation and limiting state probability evaluation of one component repairable model. Absorbing states.
Continuous Markov Processes: Modeling concepts, State space diagrams, Stochastic Transitional Probability Matrix, Evaluating time dependent and limiting state Probabilities of one component repairable model. Evaluation of Limiting state probabilities of two component repairable model.

UNIT - V
Approximate system Reliability analysis of Series systems, parallel systems with two and more than two components, Network reduction techniques. Minimal cutest/failure mode approach.

TEXT BOOKS:
1. "Reliability evaluation of Engineering systems", Roy Billinton and Ronald N Allan, BS Publications.
2. "Reliability Engineering", Elsayed A. Elsayed, Prentice Hall Publications.

REFERENCES:

1. "Reliability Engineering: Theory and Practice", By Alessandro Birolini, Springer Publications.
2. "An Introduction to Reliability and Maintainability Engineering", Charles Ebeling, TMH Publications.
3. "Reliability Engineering", E. Balaguruswamy, TMH Publications.

MECHANICAL ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

ENGINEERING RESEARCH METHODOLOGY (Open Elective – II)

UNIT - I
Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research and Scientific Method, Important of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.
Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Technique involved in Defining a Problem.

UNIT - II
Literature Survey: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. **Literature Review**: Need of Review, Guidelines for Review, Record of Research Review.

UNIT - III
Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

UNIT - IV
Data Collection: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non Parametric methods, Descriptive Statistics, Measures of central tendency and Dispersion, Hypothesis testing, Use of Statistical software.
Data Analysis: Deterministic and random data, Uncertainty analysis, Tests for significance: Chi-square, student's t-test, Regression modeling, Direct and Interaction effects, ANOVA, F-test, Time Series analysis, Autocorrelation and Autoregressive modeling.

UNIT - V
Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. **Research Proposal Preparation**: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

REFERENCES:
1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Ratan Khananabis and Suvasis Saha, Research Methodology, Universities Press, Hyderabad, 2015.
4. Y. P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
5. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
6. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
7. Naval Bajjai "Business Research Methods" Pearson 2011.
8. Prahalad Mishra " Business Research Methods " Oxford 2016

COMPUTER SCIENCE AND ENGINEERING

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

MACHINE LEARNING (Open Elective - II)

Prerequisites:
- Data Structures
- Knowledge on statistical methods

Course Objectives:
- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes:
- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
- Understand the Neural Networks and its usage in machine learning application.

UNIT - I
Introduction - Well-posed learning problems, designing a learning system Perspectives and issues in machine learning
Concept learning and the general to specific ordering – Introduction, A concept learning task, concept learning as search, Find-S: Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination algorithm, Remarks on Version Spaces and Candidate Elimination, Inductive Bias.
Decision Tree Learning – Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning Algorithm Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning.

UNIT - II
Artificial Neural Networks Introduction, Neural Network Representation, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Networks and the Back propagation Algorithm.
Discussion on the Back Propagation Algorithm, An illustrative Example: Face Recognition
Evaluation Hypotheses – Motivation, Estimation Hypothesis Accuracy, Basics of Sampling Theory, A General Approach for Deriving Confidence Intervals, Difference in Error of Two Hypotheses, Comparing Learning Algorithms.

UNIT - III
Bayesian learning - Introduction, Bayes Theorem, Bayes Theorem and Concept Learning Maximum Likelihood and Least Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Minimum Description Length Principle , Bayes Optimal Classifier, Gibs Algorithm, Naïve Bayes Classifier, An Example: Learning to Classify Text, Bayesian Belief Networks, EM Algorithm.
Computational Learning Theory – Introduction, Probably Learning an Approximately Correct Hypothesis, Sample Complexity for Finite Hypothesis Space, Sample Complexity for Infinite Hypothesis Spaces, The Mistake Bound Model of Learning.
Instance-Based Learning – Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT - IV
Pattern Comparison Techniques, Temporal patterns, Dynamic Time Warping Methods, Clustering, Codebook Generation, Vector Quantization
Pattern Classification: Introduction to HMMS, Training and Testing of Discrete Hidden Markov Models and Continuous Hidden Markov Models, Viterbi Algorithm, Different Case Studies in Speech recognition and Image Processing

UNIT - V

Analytical Learning – Introduction, Learning with Perfect Domain Theories : PROLOG-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operations.

Combining Inductive and Analytical Learning – Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis.

TEXT BOOKS:
1. Machine Learning – Tom M. Mitchell,- MGH
2. Fundamentals of Speech Recognition By Lawrence Rabiner and Biing – Hwang Juang.

REFERENCE BOOK:
1. Machine Learning : An Algorithmic Perspective, Stephen Marsland, Taylor & Francis