NOIDA INTERNATIONAL UNIVERSITY
GAUTAM BUDH NAGAR, UP

EVALUATION SCHEME & SYLLABUS
FOR
MASTER OF TECHNOLOGY
In
Power System Operation & Control (Regular)

AS PER
AICTE MODEL CURRICULUM
[Effective from the Session: 2019-20]

Programme Outcomes

1. PO1: Apply the knowledge of science and mathematics in designing, analyzing and using power convertersfor various industrial and domestic applications.

2. PO2: Design the modern electric machines, drives, power converters, and control circuits for specific application.

3. PO3: Use modern tools, professional software platforms, embedded systems for thediversified applications.

4. PO4: Explore ideas for inculcating research skills.

5. PO5: Solve the problems which need critical and independent thinking to show reflective learning.

6. PO6: Imagine the larger picture and correlate the domain knowledge with the globalindustrial problems.

Semester-1								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
PPCT1	Power System Analysis	3	0	0	40	60	100	3
PPCT2	Computer Aided Power System Protection	3	0	0	40	60	100	3
PPE1x	Program Elective-1 (1) Non Linear Control System (2) Renewable Energy System (3) Electrical Power Distribution	3	0	0	40	60	100	3
PPE2x	Program Elective-2 (1) FACTS and Customer Power Device (2) Advance Digital Signal Processing (3) Power System Reliability	3	0	0	40	60	100	3
MTC01	Research Methodology and IPR	2	0	0	40	60	100	2
	Audit Course-1	2	0	0	40	60	100	0
PPCL1	Power System & Simulation Lab	0	0	4	40	60	100	2
PPCL2	Power System Steady State Analysis Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Semester-2								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
PPCT3	Power System Operation & Control	3	0	0	40	60	100	3
PPCT4	Extra High Voltage AC Transmission	3	0	0	40	60	100	3
PPE3x	Program Elective-3 (1) Power Quality (2) Power Apparatus Design (3) Restructured Power System	3	0	0	40	60	100	3
PPE4x	Program Elective-4 (1) Power System Transients (2) AI Techniques (3) SCADA System & Applications	3	0	0	40	60	100	3
	Audit Course-2	2	0	0	40	60	100	0
MTC02	Mini Project	0	0	4	100	0	100	2
PPCL3	Power Quality Lab	0	0	4	40	60	100	2
PPCL4	Artificial Intelligence Lab	0	0	4	40	60	100	2
Total							**800**	**18**

Audit course 1 & 2

MAC01. English for Research Paper Writing
MAC02. Disaster Management
MAC03. Sanskrit for Technical Knowledge
MAC04. Value Education
MAC05. Constitution of India
MAC06. Pedagogy Studies
MAC07. Stress Management by Yoga
MAC08. Personality Development through Life Enlightenment Skills

Semester-3								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
PPE5x	Program Elective-5 (1) Smart Grids (2) Industrial Load Modeling & Control (3) Dynamics of Linear System	3	0	0	40	60	100	3
	Open Elective	3	0	0	40	60	100	3
MTC03	Dissertation Phase-1	0	0	20	500	0	500	10
Total							**700**	**16**

Semester-4								
Paper code	**Subject**	**L**	**T**	**P**	**Marks(ISA)**	**Marks(ESE)**	**Total**	**Credit**
MTC04	Dissertation Phase-2	0	0	32	500	200	700	16
Total							**700**	**16**

GRAND TOTAL	**3000**	**68**

Open Elective

MOE01. Business Analytics
MOE02. Industrial Safety
MOE03. Operations Research
MOE04. Cost Management of Engineering Projects
MOE05. Composite Materials
MOE06. Waste to Energy

Course Code: PPCT1 **Course Name: POWER SYSTEM ANALYSIS**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Perform steady-state analysis for a balanced three-phase power system.
- Construct a composite system by the interconnection of the elements of a power system.
- Analyze multi-node power systems using an admittance matrix or impedance matrix representation of the power system

Design a transmission addition to a power system using tools and methods from the course.

Course Description:

The **course** deals with exploring the ways and means to perform **power system analysis** in normal operation and under symmetrical and unsymmetrical faults. ... Computer-aided **analysis** of the performance of large-scale **power systems** is one of the central learning **objectives**.

Course Contents:

Unit-I

Power System Network Matrices

Graph Theory: Definitions, Bus Incidence Matrix, Y bus formation by Direct and Singular Transformation Methods, Numerical Problems. Formation of Z Bus: Partial network, Algorithm for the Modification of Z Bus Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses (Derivations and Numerical Problems). - Modification of Z Bus for the changes in network.

Unit-II Power flow Studies

Necessity of Power Flow Studies – Data for Power Flow Studies – Derivation of Static load flow equations – Load flow solutions using Gauss Seidel Method: Acceleration Factor, Load flow solution with and without P-V buses, Algorithm and Flowchart. Numerical Load flow Solution for Simple Power Systems (Max. 3-Buses): Determination of Bus Voltages, Injected Active and Reactive Powers (Sample One Iteration only) and finding Line Flows/Losses for the given Bus Voltages. Newton Raphson Method in Rectangular and Polar Co-Ordinates Form: Load Flow Solution with or Without PV Busses- Derivation of Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods-Comparison of Different Methods–DC load Flow.

Unit-III Short Circuit Analysis

Per-Unit System Representation. Per-Unit equivalent reactance network of a three phase Power System, Numerical Problems. Symmetrical fault Analysis: Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors, Numerical Problems. Symmetrical Component Theory: Symmetrical Component Transformation, Positive, Negative and Zero sequence components: Voltages, Currents and Impedances. Sequence Networks: Positive, Negative and Zero sequence Networks, Numerical Problems. Unsymmetrical Fault Analysis: LG, LL, LLG faults with and without fault impedance, Numerical Problems.

Course Learning Outcomes(CLOs) :

After completing this course, the student will be able to comprehend, analyse, assess and apply, as applicable, the following:.

- methods for power system analysis in steady state operation
- principles of modelling and analysis of power systems subject to symmetrical and unsymmetrical faults
- the mathematical description and use of symmetrical component theory
- modelling of generators, transformers, lines and cables in the positive, negative and zero sequence systems
- the significance of different earthing/grounding methods

TEXT BOOKS:

1.Computer Techniques in Power System Analysis by M.A.Pai, TMH Publications. 2. Modern Power system Analysis – by I.J.Nagrath&D.P.Kothari: Tata McGraw-Hill Publishing Company, 2nd edition.

REFERENCE BOOKS:

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
3. Power System Analysis by HadiSaadat – TMH Edition.
4. Power System Analysis by B.R.Gupta, Wheeler Publications.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPCT2 **Course Name:** COMPUTER AIDED POWER SYSTEM PROTECTION

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To emphasize the fundamentals of power system analysis while employing a computer for computational purpose for modeling and simulation of a system
- This course will handle three basis problems of short circuit analysis, load flow studies and the transient stability.
- At the end the student will be in a position to develop his own program for such pourposes and feel more confident while using commercial software in the field.

Course Description:

Simulation methodologies of complex energy systems and transducers, Basic hardware scheme of a microprocessor based relay. Signal processing algorithms for energy system protection. Microprocessor- based protection of generators, transmission line, power transformer, and induction motors. Automatic testing of protective relays.

Course Contents:

Unit-I

Introduction To Computer Relaying: Development of computer relaying, Historical background, Expected benefits of computer relaying, Computer relay architecture, Analog to digital converter, Anti-aliasing filter, Substation computer hierarchy.

Relaying Practices: Introduction to protection systems, Functions of a protection system, Protection of transmission lines, Transformer, reactor & generator protection, Bus protection, Performance of current & voltage transformers.

Unit-II

Mathematical Basis For Protective Relaying Algorithms: Introduction, Fourier series, Other orthogonal expansion, Fourier transform, Use of fourier transform, Discrete fourier transform, Introduction to probability & random processes, Random processes, Kalman filtering.

Transmission Line Relaying: Introduction, Sources of error, relaying as parameter estimation, Beyond parameter estimation, Symmetrical component distance relay, protection of series compensated lines.

Unit-III

Protection Of Transformers, Machines & Buses: Introduction, Power transformer algorithms, Generator protection,, Motor protection, Digital bus protection.

Hardware Organisation In Integrated Systems: The nature of hardware issues, Computers for relaying, The substation environment, Industry environmental standards, Countermeasures against EMI, Supplementary equipment, Redundancy & backup, Servicing, training & maintenance.

System Relaying & Control: Introduction, Measurement of frequency & phase, Sampling clock synchronization, Application of Phasor measurements to state estimation, Phasor measurement in dynamic state estimation, Monitoring.

Developments In New Relaying Principles: Introduction, Traveling waves on single-phase lines, Traveling waves on three-phase lines, Traveling waves due to faults, Directional wave relays, Traveling wave distance relay, Differential relaying with phasors, Traveling ` wave differential relays, Adaptive relaying.

Course Learning Outcomes (CLOs) :

After completing this course, the student will be able to comprehend, analyse, assess and apply, as applicable, the following:.

1. Recent techniques and computer application for modeling of practical and large interconnected power system networks using programming languages.
2. Recent methodologies for simulation and analysis of power system networks like real and reactive power flows and optimal scheduling.
3. Effect of outage of any important component of power system on the operation and reliability of power systems.
4. Algorithm required to find out parameters for monitoring and control of power system in real time from actual measurement data.

5. Computer Algorithms used to solve algebro-differential pertaining to power system to assess the stability performance of power systems.

Text Book

1.A.G. Phadke and J.S. Thorp, " Computer Relaying for Power Systems", John Wiley and Sons, 1994

G.W. Stagg and A. H. El-Abiad, “Computer methods in power system analysis”, McGraw Hill, 1971.

2.G. L. Kusic, “Computer aided power system analysis”, PHI, 1986.

3.L.P.Singh, “ Advanced power system analysis and dynamics”, Wiley Eastern

4.J. Arillage and C.P. Arnold, “Computer analyzing power system”, John Wiley, 1990.

5.A. R. Bergen and V. Vittal, “Power system analysis”, Prentice Hall, 2000.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPE1x **Course Name: NON-LINEAR CONTROL SYSTEMS**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1.The ability to understand the characteristics of various types of nonlinearities present inphysical systems.

2.The ability to carry out the stability analysis of non-linear control systems.

3.The ability to carry out the analysis and design of digital control systems.

4.The ability to design compensators for digital control system to achieve desiredspecifications.

5.The ability to represent digital control systems using state space models.

6.The ability to analyze the effect sampling on stability, controllability and observability.

7.The ability to design digital controllers for industrial applications

Course Description:

Methods for analysis and design of **nonlinear systems**, with an emphasis on **nonlinear control systems**. The **course** includes: ... 3) **Nonlinear control** design, including Lyapunov-based **control**, Energy-based **control**, Cascaded **control**, Passivity-based **control**, Input-Output linearization, and Backstepping.

Course Contents:

Unit-I

Review of time domain and frequency domain responses, analysis of time and frequency domain common tools, time and frequency domain specifications, and their relationship. Review of State Space representations in controllable canonical form, observer canonical form, diagonal form, etc., Eigen value, Eigen vector, and their significance.

Introduction to non-linear system, common differences with linear system, types of nonlinearities, Inherent nonlinearity (Saturation, dead zone, Hysteresis, Back-lash), Intentional non-linearity, Non-linear phenomenon (Frequency-amplitude dependence, multivalved response and jump resonance, sub harmonic oscillation, limit cycle, Frequency entrainment, Asynchronous quenching)

Unit-II

DESCRIBING FUNCTION ANALYSIS

Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems.

PHASE-PLANE ANALYSIS

Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

STABILITY ANALYSIS

Stability in the sense of Lypanov, Lypanov's stability and Lypanov's instability theorems.Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems

Unit-III

MODAL CONTROL

Effect of state feedback on controllabilitpy and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer.

Liapunov's concept of stability, asymptotically stable, uniformly asymptotically stable, uniformly asymptotically stable in the large, instability, Liapunov function, Liapunov's theorems, stability analysis of linear and non-linear systems using Liapunov concept.

Minimization of functional of single function, constrained minimization.Minimum principle. Control variable inequality constraints. Control and state variable inequality constraints.EulerLagrangine Equation.

Unit-IV

OPTIMAL CONTROL

Formulation of optimal control problem.Minimum time, Minimum energy, minimum fuel problems. State regulator problem. Output regulator problem.Tracking problem, Continuous-Time Linear Regulators.

Concept of linearization, feedback linearization, sliding mode control. Phase plane analysis, classification of singular points, limit cycle vs closed trajectory, stability analysis using phase plane analysis. Describing function of common non-linearities, stability analysis using describing function.

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Course Learning Outcomes(CLOs) :

After studying this course the students would gain enough knowledge

1.The ability to understand the characteristics of various types of nonlinearities present inphysical systems.

2.The ability to carry out the stability analysis of non-linear control systems.

3.The ability to carry out the analysis and design of digital control systems.

4.The ability to design compensators for digital control system to achieve desiredspecifications.

5.The ability to represent digital control systems using state space models.

6.The ability to analyze the effect sampling on stability, controllability and observability.

7.The ability to design digital controllers for industrial applications

TEXT BOOKS:

1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996

REFERENCE BOOKS:

1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.

Online links for study & reference materials:

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Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPE1x **Course Name: RENEWABLE ENERGY SYSTEM**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1. To Understand the Need, importance and scope of non conventional and alternate **energy resources**.
2. To understand role significance of **solar energy**.
3. **Course Description:**

The primary **objective** for deploying **renewable energy** in India is to advance economic development, improve **energy** security, improve access to **energy**, and mitigate climate change

Course Contents:

Unit-I

Introduction, Distributed vs Central Station Generation Sources of Energy such as Micro-turbines, Sources of Energy such as Micro-turbines

Unit-II

Introduction to Solar Energy, Wind Energy, Combined Heat and Power,Hydro Energy, Tidal Energy, Wave Energy,Geothermal Energy, Biomass and Fuel Cells.

Unit-III

Power Electronic Interface with the Grid,Impact of Distributed Generation on the Power System,Power Quality Disturbances.

Unit-IV

Transmission System Operation,Protection of Distributed GeneraEconomics of Distributed Generators,Case Studies

Course Learning Outcomes(CLOs) :

After studying this course the students would gain enough knowledge

Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.

2.Know the need ofrenewable energy resources, historical and latest developments.

3.Describe the use of solar energy and the various components used in the energy productionwith respect to applicationslike-heating, cooling, desalination, power generation, drying, cooking etc.

4.Appreciate the need of Wind Energy and the various components used in energy generationand know the classifications.

5.Understand the concept of Biomassenergy resources and their classification, types of biogas Plants-applications

6.Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations

Text Books

RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies",2nd Ed. Prentice Hall of India ,2011Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011,Wiley –IEEE Press

Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.

Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010

James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPE1x **Course Name: ELECTRICAL POWER DISTRIBUTION**
Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1 .Load modeling of distribution networks
2. Application of distribution transformers
3. Design of sub-transmission lines
4. Voltage drop, Power losses
5. Distribution system voltage regulation
6. Distribution system protection
7. Distribution system reliability

Course Description:

We cover the study and design of distribution stations and sub-transmission lines. We analyze primary and secondary distributions systems, voltage drop and power losses. Also, the student will learn advanced system voltage regulation, system protection and system reliability. Markov processes are studied and finally state transmission models are reviewed

Course Contents:

Unit-I

General : Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modeling and characteristics: definition of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor-Relationship between the load factor and loss factor - Classification of loads (Residential, Commercial, Agricultural and Industrial) and their characteristics. Distribution Feeders and Substations: Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, and feeder-loading.

Unit-II

Design practice of the secondary distribution system. Location of Substations: Rating of a Distribution Substation, service area with primary feeders. Benefits derived through optimal location of substations. System analysis: Voltage drop and power loss calculations, Derivation for volt-drop and power loss in lines, manual methods of solution for radial networks, three-phase balanced primary lines, non-three-phase primary lines.

Protective devices and coordination: Objectives of distribution system protection, types of common faults and procedure for fault calculation.

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Unit-III

Protective Devices: Principle of operation of fuses, circuit reclosers, line sectionalizer and circuit breakers. Coordination of protective devices: General coordination procedure.

Capacitive compensation for power factor control: Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched) power factor correction, capacitor location. Economic justification.Procedure to determine the best capacitor location.

Voltage control : Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation.

Course Learning Outcomes(CLOs) :

After completing this course the students should be able to complete the design of a power distribution system network. More specifically, the students should be able to perform the calculations and analysis of the following faults:

- Load modeling
- Design of sub-transmission lines
- Voltage drop
- Power loss calculations
- Application of capacitors in distribution systems
- Voltage regulation

Reference Books:

1. “Electric Power Distribution System Engineering “ byTuranGonen, Mc.Graw-Hill Book Company,1986.
2. Electric Power Distribution-by A.S.Pabla, Tata McGraw-Hill PublishingCompany, 4th edition, 1997**Online links for study & reference materials:**

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPE1x **Course Name: FACTS AND CUSTOMER POWER DIVICE**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Understand the operation of Static VAR Compensator (SVC).
- Understand the operation of Static Synchronous Compensator (STATCOM) (L2)
- Compare SVC and STATCOM (L3)

Course Description:

Overview of Power Transfer issues in Transmission Systems and Power Quality issues in Distribution systems. Multilevel VSI configurations, modulation and control techniques, high-power, medium-voltage applications. FACTS Devices - Series, Shunt and Unified configurations and applications. Custom Power Devices - DVR, DSTATCOM and UPQC

Course Contents:

Unit-I

Transmission interconnections, power flow in an AC System, loading capability limits, Power flow and Dynamic stability considerations, importance of controllable parameters.Opportunities for FACTS, basic types of FACTS controllers, benefits from FACTS controllers, Requirements and Characteristics of High Power devices – Voltage and Current rating, losses and speed of switching, parameter trade-off of devices.
Basic concept of Voltage source converter, Single phase full wave bridge converter, Single phase-leg (pole) operation, Square-wave voltage harmonics for a single phase Bridge, 3 Phase full wave bridge converter.

Unit-II

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, comparison of current source converters with voltage source converters.
Objectives of shunt compensation, mid point voltage regulation for line segmentation, End of line voltage support to prevent voltage instability, improvement of transient stability, Power oscillation damping. Methods of controllable var generation: variable impedance type static var generators – TCR and TSR, TSC, FC-TCR, TSC-TCR, switching converter type var generators, hybrid var generators.

Unit-III

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 compensation control.
Static series compensators : Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.

Course Learning Outcomes(CLOs) :

- At the end of the course, the student will be able to
- Distinguish the performance of Transmission line with and without FACTS Devices CO2: Compare the SVC and STATCOM
- Understand the operation and control of various Static Series Compensators
- Understand the operation and control of Unified Power Flow Controller
- Distinguish various power quality issues and how are they mitigated by various FACTS Devices

Reference Book:

1. "Understanding FACTS "N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is available:--Standard Publications, 2001.
2. "Flexible a c transmission system (FACTS)" Edited by YONG HUE SONG and ALLAN T JOHNS, Institution of Electrical Engineers, London.

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPE1x **Course Name: ADVANCED DIGITAL SIGNAL PROCESSING**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Students learn the essential advanced topics in digital signal processing that are necessary for successful graduate-level research.
- The course includes a review of the linear constant-coefficient system properties covered in an undergraduate DSP course, and then examines a variety of multirate filter structures, time-varying and adaptive systems, fast algorithms, and other topics relevant to the research areas of the students.

Course Description:

Selected topics in digital signal processing such as digital speech processing, multidimensional digital signal processing, spectrum estimation, space-filling curves, and error analysis.

Course Contents:

Unit-I

Digital Filter Structure

Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures.

Digital filter design Preliminary considerations-Bilinear transformation method of IIR filter design-design of Low pass highpass-Bandpass, 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-II

DSPalgorithm implementation Computation of the discrete Fourier transform- Number representation-Arithmetic operations-handling of overflow-Tunable digital filters-function approximation.

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 ratio in Low -order IIR filters-Low-Sensitivity Digital filters-Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters- Round-off errors in FFT Algorithms.

Unit-III

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 & torchy method.

Course Learning Outcomes(CLOs) :

After the successful completion of the course, student should be able to:

1.Know the analysis of discrete time signals.

2.To study the modern digital signal processing algorithms and applications.

3.Havean in-depth knowledge of use of digital systems in real time applications

4.Apply the algorithms for wide area of recent applications.

Reference Books:

1. Digital signal processing-sanjit K. Mitra-TMH second edition
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition-9th reprint
3 Digital Signal Processing principles, algorithms and Applications – John G.Proakis -PHI –3rd edition-2002
4 Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001

5 Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold Digital Filter Analysis and Design-Auntonian-TMH.

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPE1x **Course Name: POWER SYSTEM RELIABILITY**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

The objectives of this course are to enable you to

1. Use the language of power system reliability analysis;
2. Develop analytical models for power system reliability analysis;
3. Implement and use algorithms for power system reliability analysis

Course Description:

The **course** gives an introduction to the main principles and **objectives** of **power system reliability** analysis: Basic terms and definitions, applications, **overview** of methodologies for contingency analysis and **reliability** analysis, **reliability** models, input data (from fault statistics), **reliability** indicators, and state- ...

Course Contents:

Unit-I

Basics of Probability theory & Distribution: Basic probability theory – rules for combining probabilities of events – Bernoulli's trials – probabilities density and distribution functions – binomial distribution – expected value and standard deviation of binomial distribution.

Network Modelling and Reliability Analysis: Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method.

Reliability functions : Reliability functions f(t), F(t), R(t), h(t) and their relationships – exponential distribution – Expected value and standard deviation of exponential distribution –Bath tub curve – reliability analysis of series parallel networks using exponential distribution – reliability measures MTTF, MTTR, MTBF.

Unit-II

Markov Modelling : Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state Probabilities. – Markov processes one component repairable system – time dependent probability evaluation using Laplace transform approach – evaluation of limiting state probabilities using STPM – two component repairable models.

Frequency & Duration Techniques : Frequency and duration concept – Evaluation of frequency of encountering state, mean cycle time, for one , two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering of merged states.

Unit-III

Generation System Reliability Analysis : Reliability model of a generation system– recursive relation for unit addition and removal – load modeling - Merging of generation load model – evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE.

Composite Systems Reliability Analysis: Decompositions method – Reliability Indices – Weather Effects on Transmission Lines.

Distribution System and Reliability Analysis: Basic Concepts – Evaluation of Basic and performance reliability indices of radial networks.

Course Learning Outcomes(CLOs) :

Upon completion of this course, students should be able to–

- Assess the reliability of engineering systems–Apply concepts of the probability theory for power systems reliability evaluation
- Do basic studies of power generation and transmission reliability
- Analyze reliability of distribution electricity networks
- Design (and expand) a system (which fulfill a specific task, e.g., a radial power distribution network) with respect to desired reliability indices

Reference Books:

1. Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York.
2. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York.
3. An Introduction to Reliability and Maintainability Engineering. Charles E.Ebeling, TATA McGraw - Hill – Edition.

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPCL1 **Course Name: POWER SYSTEMS & SIMULATION LAB**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- provide better understanding of power system analysis through digital simulation.
- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools.

Course Description:

To present a problem oriented knowledge of **power system** analysis methods. To address the underlying concepts & approaches behind analysis of **power system** network using software tools. To identify & formulate solutions to problems relevant to **power system** using software tools.**Course Contents:**

1. Fault Analysis of 3-phase Alternator
2. Determination of Xd and Xq of 3-phase salient pole Synchronous motor
3. IDMT (Inverse Definite Minimum Time) relay characteristics
4. Determination of breakdown strength of oil by variable distance electrodes.
5. Determination of transmission line parameters.
6. Fault analysis (LL, LG, and LLL) of transmission lines.

SIMULATION BASED (USING MATLAB OR ANY OTHER SOFTWARE)

1. To obtain steady-state, transient and sub-transient short-circuit currents in an alternator.
2. To formulate the Y-Bus matrix and perform load flow analysis.
3. To compute voltage, current, power factor, regulation and efficiency at the receiving end of a three phase Transmission line when the voltage and power at the sending end are given. Use Π model.
4. To perform symmetrical fault analysis in a power system.
5. To perform unsymmetrical fault analysis in a power system.

Course Learning Outcomes(CLOs) :

the end of the course, the student should have the

- Ability to understand the concept of MATLAB programming in solving power systems problems.
- Ability to understand power system planning and operational studies.
- Ability to acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
- Ability to analyze the power flow using GS and NR method.
- Ability to find Symmetric and Unsymmetrical fault.
- Ability to understand the economic dispatch.
- Ability to analyze the electromagnetic transients.
- Ability to acquire knowledge on power system analysis methods.
- Ability to effectively employ different techniques to analyze different power system network conditions.

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: : PPCL2 **Course Name: POWER SYSTEM SEDAY STATE ANALYSIS LAB**

Course Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- provide better understanding of power system analysis through digital simulation.
- To present a problem oriented knowledge of power system analysis methods.
- To address the underlying concepts & approaches behind analysis of power system network using software tools.
- To identify & formulate solutions to problems relevant to power system using software tools.

Course Description:

To present a problem oriented knowledge of **power system** analysis methods. To address the underlying concepts & approaches behind analysis of **power system** network using software tools. To identify & formulate solutions to problems relevant to **power system** using software tools.

Course Contents:

1.Power Systems & Power Electronics Lab
2.Computer Simulation Lab
3.Simulation of IGBT Inverters.
4.Simulation of Thyristor Converters.
5.Transient Stability Studies.
6.Short Circuit Studies.
7.Load Flow Studies
8.Load Forecasting and Unit Commitment

Course Learning Outcomes(CLOs) :

the end of the course, the student should have the

- Ability to understand the concept of MATLAB programming in solving power systems problems.
- Ability to understand power system planning and operational studies.
- Ability to acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
- Ability to analyze the power flow using GS and NR method.
- Ability to find Symmetric and Unsymmetrical fault.
- Ability to understand the economic dispatch.
- Ability to analyze the electromagnetic transients.
- Ability to acquire knowledge on power system analysis methods.
- Ability to effectively employ different techniques to analyze different power system network conditions.

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPCT3 **Course Name: POWER SYSTEM OPERATION AND CONTROL**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the electrical power plant operation and control with respect to its economic aspect.
- To know the importance of compensation in power system and study the different compensating techniques.
- Study about different transients and their protection those are introduced in power system.

Course Description:

this **course** is designed to develop awareness about these concepts in diploma pass outs so that they may appreciate different equipment and techniques being employed to ensure **power system** stability, to **control** flow of **power** and to ensure economic dispatch of load..

Course Contents:

Unit- I

Unit commitment problem : Introductions to UCP, thermal &Hydral constraints in Unit commitment : Priority list scheme method, unit commitment problem solution by priority list scheme method, Unit commitment problem solutions by Dynamic programming Approach. Introduction, advantages of DP method over priority list scheme, Back word DP approach, forward DP approach algorithm and their flow charts solution UCP using Dynamic program method.

Unit-II

Load Frequency Control-I : Necessity of keeping frequency constant. Definition of control area, single area control, Block diagram representation of an isolated Power System, Steady State analysis, Dynamic response-Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation, steady state response, load frequency control and Economic dispatch control. Load Frequency Control-II : Load frequency control of 2-area system : uncontrolled case and controlled case, tie-time bias control.

Unit-III

Optimal LF control-steady state representation, performance Index and optimal parameter adjustment.Generation with limited Energy supply : Take-or-pay fuel supply contract, composite generation production cost function. Solution by gradient search techniques, Hard limits and slack variables, Fuel scheduling by linear programming.

Unit- IV

Interchange Evaluation and Power Pools Economy Interchange, Economy interchange Evaluation, Interchange Evaluation with unit commitment, Multiple Interchange contracts. After-the-fact production costing, Transmission Losses in transaction Evaluation, other types of Interchange, power pools.

Course Learning Outcomes(CLOs) :

1.Identify and explain the different methods of generation, distribution, control and compensation involved in the operation of power systems.

2.Design the mathematical models of the mechanical and electrical components involved in the operation of power systems and demonstrate the understanding of the open loop and closed loop control practices associated with the voltage and frequency control of single area or interconnected multi area power systems.

3.Specify the equivalent electrical parameters of transmission line to prepare and analyze models to predict the range and ratings of the equipments to be used, the protection required against line transients and determine the appropriate methods of compensation required for operational stability

4.Solve the problems related to the economic dispatch of power, plant scheduling, unit commitment and formulate strategies to minimize transmission line losses and penalties imbibed.

Reference Books :

1. Electrical Energy Systems Theory - by O.I.Elgerd, Tata McGraw-Hill Publishing Company Ltd, 2nd edition.
2. Power System Analysis by HadiSaadat – Tata McGraw Hill Publications
3. Power Generation, Operation and Control - by A.J.Wood and B.F.Wollenberg,Johnwiley& sons Inc. 1984.
4. Modern Power System Analysis - by I.J.Nagrath&D.P.Kothari, Tata McGraw-Hill Publishing Company ltd, 2nd edition.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPCT2 **Course Name: EXTRA HIGH VOLTAGE AC TRANSMISSION**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand the basic concepts of EHV AC and HVDC transmission..

Course Description:

A **high-voltage**, direct current (HVDC) electric power **transmission** system (also called a power superhighway or an electrical superhighway) uses direct current (DC) for the bulk **transmission** of electrical power, in contrast with the more common **alternating current** (**AC**) systems.

Course Contents:

Unit- I Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit-II Residential and Commercial Electrical Systems

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit-III Illumination Systems

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting

.**Unit- IV Industrial Electrical Systems I**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit- V Industrial Electrical Systems II

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Module 6: Industrial Electrical System Automation

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

.**Course Learning Outcomes(CLOs) :**

- 1. Learn the basic concepts of EHV AC and HVDC transmission.
  2. To identify the electrical requirements for HVDC lines.
  3. To identify the components used in AC to DC conversion.
  4. To understand the operation of HVDC conversion technology.
  5. To understand the fundamental requirements of HVDC transmission line design.
  6. Students can analyze travelling waves
  7. Students will understand the effects of corona like Audible noise.
  8. To identify factors affecting AC-DC transmission. Basics about Illumination and its types
-
- **TEXT BOOKS:**
- 1. EHVAC Transmission Engineering by R. D. Begamudre, New Age International (p) Ltd.
- 2. HVAC and DC Transmission by S. Rao

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE3x **Course Name: POWER QUALITY**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

To discuss various power quality issues and different methods to control them.

Course Description:

Power Quality definition. European standards and recommendations. Harmonics. Voltage variations and flickers. Voltage unbalance. Power factor. Power quality measurements. Measuring instrumentation and equipment. Applied measures for power quality improvement. Including Power quality in distribution planning and operation.

Course Contents:

Unit- I Introduction:

power quality (PQ) problem, Voltage sag, Swell , Surges, Harmonic, over voltages, spikes, Voltage fluctuations, Transients, interruption overview of power quality phenomenon , Remedies to improve power quality, power quality monitoring.

Unit-II Interruptions:

Definition, Difference between failure, outage, causes and 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.

Unit-III Voltage Sag:

Characterization of voltage sag, definition, causes of voltage sag, voltage sag magnitude, monitoring, theoretical calculation of voltage sag magnitude voltage sag calculation in non-radial systems, meshed systems, voltage sag duration

Unit- IV PQ considerations in Industrial Power Systems:

voltage sag effects, equipment behaviour 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 drive and its operation, mitigation methods of DC drives.

Unit- V Mitigation of Interruptions and Voltage Sags: Overview of mitigation methods- form 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.

Course Learning Outcomes(CLOs) :

- To Study the production of voltages sags.
- To Study the interruptions types and its influence in various components.
- To Study the Effects of harmonics on various equipment's.
- Understand **power quality** monitoring and classification techniques.
- **Reference Book:**

1. " Understanding Power Quality Problems" by Math H J Bollen, IEEE Press.
2. Electrical power quality –R C Dugan, M.F,MGranghar, H.W.Beaty-TMH.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE3x **Course Name: POWER APPARTUS DESIGN**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Able to Identify various kind of tests related with power equipment'slocated in electric power sub stations networks.
- Able to describerole of diagnostic tests before a catastrophic failure of power apparatus
- Applyprinciples and tools to carry out AC and DC tests to highlight dielectric strength of insulation used in power transformers.
- Able to develop skill for using safe practices and prevent accidents, human loss, asset damage in event of fires etc.if at all it occursin field despite precautions.

Course Description:

he design of Electrical Systems deals with the study and application Electrical Power System, Electrical Machines, Control systems & Automation, Instrumentation, Microprocessors, Power Electronics, Digital Signal Processing and telecommunications

Course Contents:

Unit- I

Principles of Design of Machines -Specific loadings, choice of magnetic
and electric loadings Real and apparent flux densities, temperature rise calculation, Separation
of main dimension for DC machinesInduction machines and synchronous machines

Unit-II

Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling

Unit-III

Specific loadings, choice of magnetic and electric loadings Real and apparent flux -densities, temperature rise calculationSeparation of main dimension for DC machinesInduction machines and synchronous machinesHeating and cooling of machines, types of ventilation, continuous and intermittent ratingGeneral considerations, output equation, emf per turn, choice of flux

Unit- IV

density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes Calculation of losses, efficiency and regulationForces winding during short circuit

Unit- V

General considerations, output equation Choice of specific electric and magnetic loadings, efficiency, power factor Number of slots in stator and rotor Elimination of harmonic torques

Design of stator and rotor winding, slot leakage flux Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data

Course Learning Outcomes(CLOs) :

- Toknow practical issues concerning need of carrying out maintenance practices in various utility substations.
- To learn various tools, type tests and routine tests to ascertain various possible faults in power apparatus.
- To knowabout characterizationof electrical dielectrics and impact on reliable operation of equipment.
- To enable students,learn procedure to carry out field tests, sampling procedure etc. to carry out lab as well as field tests.
- To learn procedures for safe operation, safety measures to beadopted in event of electrical accidents.
- **Reference Books**
- 1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
- 2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
- 3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai& Sons, 5th Edition

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code:PPE3x **Course Name: RESTRUCTRED POWER SYSTEM**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

To explain basic concepts and issues related with restructuring and deregulation of power industry**Course Description:**

This **course** is intended to provide a comprehensive treatment towards understanding of the new dimensions associated with the **power systems**. The **course** will initially bring out the differences between the conventional **power system** operation and the **restructured** one.**Course Contents:**

Unit- I

Fundamentals of restructured system,Market architecture,Load elasticity,Social welfare maximization, OPF: Role in vertically integrated systems and in restructured markets

Congestion management

Unit-II

Optimal bidding,Risk assessment, Hedging, Transmission pricing, Tracing of power,Ancillary services, Standard market design, distributed generation in restructured markets

Unit-III

Developments in India, IT applications in restructured markets, Working of restructured power systems, PJM, Recent trends in Restructuring

Course Learning Outcomes(CLOs) :

- Identify, formulate and solve electrical engineering problems in the broad area like power systems and itseconomics.
- Understand market models and mechanisms for electricity as acommodity.
- Appreciate legal, financial and economic issues related with transmission congestion management, locational marginal pricing and ancillarymanagement.
- Appreciate issues like fairness and social welfare with reference to transmission system usage and loss allocation.
- Appreciate the need of reforms in power sector with focus on Indian powersector

Reference Books

1. LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE4x **Course Name: POWER SYSTEMS TRANSIENTS**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- Theoretical analysis methods and mathematical representation of power systems
- The range of problems and frequencies: lightning, switching, and temporary overvoltages; electromechanical transients
- Electromagnetic transients and traditional analysis methods

Course Description:
Introductory **description** of high voltage equipment and substations. Analysis of overvoltages in **electrical systems** in addition to an **overview** of protective measures as design, grounding, shielding and surge protection.

Course Contents:

Unit- I
Introduction To Fast Transients:
Origin and nature of power system Transients, traveling waves on transmission system, the line equation, the shape attenuation and distortion of waves, reflection of traveling waves , successive reflections, traveling waves on multi conductor systems, transition points on multi conductor circuits.
Unit-II Lightning:
Charge formation, mechanism of lightning stroke. Mathematical model of lightning stroke.
Theory Of Grounds Wires:
Direct stoke to a tower, effect of reflection up and down the tower, the counterpoise.
Unit-III Switching surges:
Normal frequency effects, high charging currents, cancellation waves, recovery voltage, restricting phenomena.Protection of transmission systems against surge.High frequency oscillations and terminal transients of transformer.
Unit- IV Insulation Coordination:
Insulation coordination procedures (IEC) for high voltage systems: Design criteria, classification of over voltages, insulation design for switching, lightning and temporary over voltages, pollution, application of arresters for protection of lines and stations, statistical methods of insulation coordination, risk of failure, test prescriptions.
Unit- V
Insulation coordination procedures (IEC) for low voltage systems: representative over voltages, selection of clearance and creepage distances, macro and micro environments, testing techniques, transient (switching and lightning) voltage surge suppression in industrial and commercial electrical installations, protection of electronic devices.
Course Learning Outcomes(CLOs) :

- have a solid foundation in understanding the source and characteristics of lightning, switching, and temporary overvoltages.
- understand travelling wave propagation on transmission lines.
- understand the critical switching transient situations.
- be able to set up differential equations for RLC circuits and solve it via stationary and transient solutions.
- understand the mode of operation and dimentioning criteria for surge arresters.
- understand the physical and electrical construction of high voltage systems..
- **REFERENCES**
- *1.*Allan Greenwood , Electrical Transients in power Systems , Wiley Iterscience, 1991
- 2.Lou Van Der Sluis, Transients in power Systems , John Wiley & Sons Ltd, 2001
- 3.RRudenterg, Transient Performance of Electric power systems, Phenomenon in Lumped Networks, MGH, 1950
- 4.RRudenterg, Electric Stroke waves in power systems, Harvard University press, Cambridge, Massachusetts, 1968
- 5.Transmission Line Reference Book, EPRI, USA, 1982.
-

.**Online links for study & reference materials:**
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE4x **Course Name: ARTIFICIAL INTELLIGENCE TECHNIQUES**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

The objectives of this course are to provide graduate students of M.Sc. Information Systems with comprehensive and in-depth knowledge of AI principles and techniques by introducing AI's fundamental problems, and the state-of-the-art models and algorithms used to undertake these problems. This course is also designed to expose students to the frontiers of AI-intensive computing and information systems, while providing a sufficiently strong foundation to encourage further research.

Course Description:

The ultimate goal of **AI** is to make a computer that can learn, plan, and solve problems autonomously. ... The main research topics in **AI** include: problem solving, reasoning, planning, natural language understanding, computer vision, automatic programming, **machine learning**.

Course Contents:

Unit- I

Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed ForwardNN, LMS and Back Propagation Algorithm

Unit- II

Feedback networks and Radial Basis Function Networks, Fuzzy Logic,Knowledge Representation and Inference Mechanism,Defuzzification Methods

Unit-III

Fuzzy Neural Networks,some algorithms to learn the parameters of the network like GA
System Identification using Fuzzy and Neural Network
propagation in conducting medium,

Course Learning Outcomes(CLOs) :

- apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
- analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

design AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.

References

1. J M Zurada , "An Introduction to ANN",Jaico**Publishing** House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg.Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley **Publishing** Com

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE4x **Course Name: SCADA SYSTEM AND APPLICATIONS**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

- To understand about the SCADA system components and SCADA communication protocols
- To provide knowledge about SCADA applications in power system

Course Description:

Supervisory control and data acquisition (**SCADA**) is a system of software and hardware elements that allows industrial organizations to : Controlling & monitoring Process in real time from Remote location. Analyze & calculation of complex the Process & maintain accordingly the Control Signals.

Course Contents:

Unit- I

Introduction to SCADA: Data acquisition systems, Evolution of SCADA,Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility
Automation,Industries SCADA

Unit- II

Industries SCADA System Components: Schemes- Remote TerminalUnit (RTU),Intelligent Electronic Devices (IED), Programmable Logic Controller(PLC), Communication Network, SCADA Server, SCADA/HMISystems,SCADA Architecture: Various SCADA architectures, advantages anddisadvantages of each system - single unified standard architecture -IEC
61850

Unit-III

SCADA Communication: various industrial communication technologies, wired and wireless methods and fiber optics. open standard, Communication protocols, SCADA Applications: Utility applications- Transmission and Distribution sector, operations, monitoring, analysis and improvement. Industries oil, gas and water, Case studies, Implementation, Simulation Exercises

Course Learning Outcomes(CLOs) :

This course gives knowledge about various system components and communication protocols of SCADA system and its applications.

Refrences

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of AmericaPublications, USA,2004.
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and RelatedSystems", Newnes Publications, Oxford, UK,2004.
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.
5. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power",PennWell 1999.

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPCL3 **Course Name: POWER QUALITY LAB**
Credit: 02 **Total Contact Hour:** 40hr

Course Objective:

electromagnetics, covering analytical, numerical, and asymptotic techniques for solving complex **electromagnetic** problems. ability not only to effectively use **electromagnetic** software, but also to understand the foundations of various codes.

Course Description:

An advanced course that examines the causes, analysis and mitigation of power quality phenomena found in low, medium and high voltage systems. Topics covered include voltage sags, surges, interruptions, transients, notching, distortions, unbalance, current distortions, and frequency variations.

Course Contents:

1. To study the effect of non linear loads on power quality.
2. To demonstrate the voltage and current distortions experimentally.
3. To reduce the current harmonics with filters.
4. To study the voltage sag due to starting of large induction motor.
5. To study the capacitor switching transients.
6. To study the effect of balanced non linear load on neutral current, in a three phase circuit
7. To study the effect of ground loop.
8. To study the effect of voltage flicker.
9. To calculate the distortion power factor.
10. Study the effect of harmonics on energy meter reading.
11. To study effect of voltage sag on electrical equipments.
12. To obtain the current harmonics drawn by power electronics interface using PSCAD software.

Course Learning Outcomes(CLOs) :

- Understand the basics of electric power systems quality
- Measure and interpret voltage, current and frequency variations and distortions
- Understand the principles of power system harmonics, harmonic indices and mitigation strategies
- Use laboratory instrumentation to measure and analyze power quality indices
- Be familiar with industrial standards on power quality requirements

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPCL4 **Course Name: ARTIFICIAL INTELLIGENCE LABORATORY**
Credit: 02 **Total Contact Hour:** 40hr

Course Objective:
The objectives of this course are to provide graduate students of M.Sc. Information Systems with comprehensive and in-depth knowledge of AI principles and techniques by introducing AI's fundamental problems, and the state-of-the-art models and algorithms used to undertake these problems

Course Description:
The ultimate goal of **AI** is to make a computer that can learn, plan, and solve problems autonomously. ... The main research topics in **AI** include: problem solving, reasoning, planning, natural language understanding, computer vision, automatic programming, **machine learning**.

Course Contents:

List of Experiments

1. Study of fuzzy logic toolbox in MATLAB.
2. Development of fuzzy membership function and rules in Fuzzy logic toolbox in MATLAB.
3. Study of ANN toolbox in MATLAB.
4. Development of Adaptive Nuro-Fuzzy Inference system (ANFIS) in MATLAB.
5. Development of fuzzy logic based model for load forecasting.
6. Development offuzzy logic based model for short term solar forecasting.
7. Development of ANN based model for short term solar forecasting.
8. Development of ANFIS based model for short term solar forecasting.

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Course Learning Outcomes(CLOs) :

- apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
- analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.

design AI functions and components involved in intelligent systems such as computer games, expert systems, semantic web, information retrieval, machine translation, mobile robots, decision support systems, and intelligent tutoring systems.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE5x **Course Name: SMART GRIDS**
Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1.Identify different tools and approaches to modelling a Smart Grid
2. Apply Optimal Power Flow (OPF) solutions to evaluate the performance of a power system with renewable energy sources
3. Analyze power system dynamics (frequency stability) to achieve active power balance.
4. Identify control-room technologies for system-wide remote monitoring, protection, and risk management of smart grid cyber security

Course Description:

The **course** provides a platform for deep understanding of **smart** features of an electric **grid**. This **course** provides knowledge about ▪ **Smart** electric power **grids**, including definition, design criteria, technology and IoT. Information processing and communications to the power **grid**.

Course Contents:

Unit- I

Introduction to Smart Grid, Evolution of Electric Grid,Concept of Smart Grid, Definitions, Need of Smart Grid,Concept of Robust &Self-Healing Grid, Present development &
International policies in Smart Grid,Introduction to Smart Meters

Unit-II ,

Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR),Outage Management System (OMS).Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation

Unit-III Geographic Information System (GIS),Intelligent Electronic Devices (IED) & their application for monitoring &protection, Smart storage like Battery, SMES, Pumped Hydro,Compressed Air Energy Storage,Wide Area Measurement System (WAMS), Phase Measurement Unit
(PMU)Concept of micro-grid, need

Unit- IV

applications of micro-grid,Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid,Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines,Captive power plants, Integration of renewable energy sources

Unit- V

Power Quality & EMC in Smart Grid,Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid,Web based Power Quality monitoring, Power Quality Audit,Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN).Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network.Basics of CLOUD Computing &Cyber Security for Smart Grid,Broadband over Power line (BPL). IP based protocols

Course Learning Outcomes(CLOs) :

At the end of this course, students will demonstrate the ability to

- Understand the structure of an electricity market in either regulated orderegulated market conditions
- .Understand how (wholesale) electricity is priced in a transmission network.
- Evaluate the trade-off between economics and reliability of anelectric power system.-Understand the impacts of renewable resources to the grid and the various issues associated with integrating such resources to the grid
- .Evaluate various investment options (e.g. generation capacities, transmission, renewables, demand-side resources, etc) in electricity markets.
- Understand the concepts and principles of Smart Grid, technology enabling, and demand participation.
-

References

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE,2011.
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC

Press, 2009
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “Smart Grid: Technology and Applications”, Wiley 2012.
4. Stuart Borlas’e, “Smart Grid:Infrastructure, Technology and solutions “CRC Press.
5. A.G.Phadke , “Synchronized Phasor Measurement and their Applications”,Springer.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE5x **Course Name: IDUSTRIAL LOAD MODELING AND CONTROL**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

1.The energy demand scenario.
2.The modellingof load and to study load demand industrially
3.To know electricity pricing models.
4.Study reactive power management in industries

Course Description:

The **course** provides a platform for deep understanding of **smart** features of an electric **grid**. This **course** provides knowledge about ▪ **Smart** electric power **grids**, including definition, design criteria, technology and IoT. Information processing and communications to the power **grid**.

Course Contents:

Unit- I

Electric Energy Scenario-Demand Side Management, Industrial LoadManagementLoad Curves-Load Shaping Objectives, Methodologies-Barriers, Classification of Industrial
Loads,Continuous and Batch processes -Load Modelling,

Unit-II ,

Electricity pricing, Dynamic and spot pricing –ModelsDirect load control- Interruptible load control, Bottom up approach- scheduling- Formulation of load, Models,Optimization and control algorithms - Case studies

Unit-III

Electricity pricing – Dynamic and spot pricing –Models,Direct load control- Interruptible load control,Bottom up approach- scheduling- Formulation of load, Models **Unit- IV** & applications of micro-grid,Formation of micro-grid, Issues of interconnection, Protection & control of micro-grid,Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines,Captive power plants, Integration of renewable energy sources

Unit- IV

Optimization and control algorithms - Case studies, Reactive power management in industries, controls-power quality impacts, application of filters Energy saving in industries

Unit- V

Cooling and heating loads load profiling, Modelling- Cool storage,Types-Control strategiesoptimal operation,Problem formulation- Case studies, Captive power units, operating and control strategies,and Power Pooling- Operation modelsEnergy banking
Industrial Cogeneration, Selection of Schemes Optimal Operating Strategies,Peak load saving

Constraints Problem formulation- Case study, Integrated Load management for Industries

Course Learning Outcomes(CLOs) :

At the end of this course, students will demonstrate the ability to

1.Knowledge about load control techniques in industries and its application.
2.Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3.Applyload management to reduce demand of electricity during peak time.4.Apply different energy saving opportunities in industries.

Refrences

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981

4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities",
",Springer.

Online links for study & reference materials:
https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: PPE5x **Course Name: DYNAMICS OF LINEAR SYSTEMS**

Credit: 3 **Total Contact Hour:** 40hr

Course Objective:

This is an introductory course on modern control systems. This course is designed to provide students a thorough knowledge on linear control systems. This course is suitable for final year UG and first year PG students who are interested to work in the field of control theory and its applications.

Course Description:

Students would learn about state space **description** of **systems**. - Students would learn fundamental concepts in **linear systems** and controls such as stability, controllability and observability. - Students would learn formal mathematical (theorem-proof style) analysis in the context of controls.

Course Contents:

Unit- I

State variable representations of systems,transfer function and transfer function matrix, · solutions of state equations, Observability and controllability, State variable representations of systems,transfer function and transfer function matrix, · solutions of state equations, Observability and controllability,

Unit-II ,

minimal realization of MIMO systems,analysis of linear time varying systems,the concepts of stability

Unit-III

State space representation of discrete systems, solution of state equations, controllability

Unit- IV

observabilty stability, analysis using Lyapunov method, State feedback of linear discrete time systems, design of observers - MATLAB Exercises

Course Learning Outcomes(CLOs) :

At the end of this course, students will demonstrate the ability to

- Review of mathematical modelling, state space representation and basics of linear vector space,
- Canonical realizations and similarity transformation,
- Time response, Stability analysis,
- Controllability and observability,
- State feedback and State estimation

Refrences

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities",
",Springer.

Online links for study & reference materials:

https://nptel.ac.in/courses/117/106/117106086/

Assessment method:(Continuous Internal Assessment = 40% , Final Examination = 60%)

Assessment -1	- 05%
Assessment-2	- 05%
Assessment-3(Midexam)	- 20%
Assessment-3	- 05%
Assessment-4	- 05%
Total Internal Assessment	**- 40%**

AUDIT COURSE-1 and 2

ENGLISH FOR RESEARCH PAPER WRITING

Subject code:MAC01 Credit 2(LTP 200)

Module1 Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Module2 Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Module3 Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Module4 key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Module5 skills are needed when writing the Methods, skills needed when writingthe Results, skills are needed when writing the Discussion, skills areneeded when writing the Conclusions.

Module6 useful phrases, how to ensure paper is as good as it could possibly be
the first- time submission.

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

DISASTER MANAGEMENT

Subject code:MAC02

Module1 Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Module2 Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Module3Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Module4 Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Module5 Risk Assessment

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Module6 Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New
Royal book Company.2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of
India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep
Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE

Subject code: MAC03

Module1 Alphabets in Sanskrit,Past/Present/Future Tense,Simple Sentences
Module2 Order ,Introduction of roots,Technical information about Sanskrit Literature
Module3 Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3."India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

VALUE EDUCATION

Subject code: MAC04

Module1 Values and self-development –Social values and individual attitudes.Work ethics, Indian vision of humanism.Moral and non- moral valuation. Standards and principles.Valuejudgements
Module2 Importance of cultivation of values.Sense of duty.Devotion, Self-reliance.Confidence, Concentration.Truthfulness, Cleanliness.Honesty, Humanity.Power of faith, National Unity.Patriotism. Love for nature, Discipline
Module3 Personality and Behavior Development - Soul and Scientific attitude.PositiveThinking.Integrity and discipline.Punctuality, Love and Kindness.Avoid fault Thinking. Free from anger, Dignity of labour.Universal brotherhood and religious tolerance.True friendship. Happiness Vs suffering, love for truth.Aware of self-destructive habits.Association and Cooperation.Doing best for saving nature.
Module4 Character and Competence –Holy books vs Blind faith. Self-management and Good health.Science of reincarnation. Equality, Nonviolence,Humility, Role of Women. All religions and same message.Mind your Mind, Self-control.Honesty, Studying effectively.

Suggested reading

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

CONSTITUTION OF INDIA

Subject code:MAC05

Module1 History of Making of the Indian Constitution: History ,Drafting Committee, (Composition & Working)

Module2 Philosophy of the Indian Constitution: Preamble, Salient Features

Module3 Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality,Right to Freedom, Right against Exploitation,Right to Freedom of Religion, Cultural and Educational Rights,Right to Constitutional Remedies,Directive Principles of State Policy,Fundamental Duties.

Module4 Organs of Governance: Parliament, Composition,Qualifications and Disqualifications, Powers and Functions,Executive,President, Governor, Council of Ministers,Judiciary, Appointment and Transfer of Judges, Qualifications,Powers and Functions

Module5 Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role.Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials,Importance of grass root democracy

Module6Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners.State Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES

Subject code:MAC06

Module1 Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology. Theories of learning, Curriculum, Teacher education.Conceptual framework, Research questions**.**Overview of methodology and Searching.

Module2 Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Module3 Evidence on the effectiveness of pedagogical practices. Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change.Strength and nature of the body of evidence for effective pedagogical practices.Pedagogic theory and pedagogical approaches.Teachers' attitudes and beliefs and Pedagogic strategies.

Module4 Professional development: alignment with classroom practices and follow-up support. Peer support. Support from the head teacher and the community. Curriculum and assessment. Barriers to learning: limited resources and large class sizes

Module5 Research gaps and future directions. Research design. Contexts,Pedagogy,Teacher education, Curriculum and assessment, Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANAGEMENT BY YOGA

Subject code:MAC07

Module1 Definitions of Eight parts of yog.(Ashtanga)

Module2 Yam and Niyam.

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Module3 Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayama

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
Subject code:MAC08

Module1 Neetisatakam-Holistic development of personality, Verses-19,20,21,22(wisdom),Verses-29,31,32 (pride & heroism),Verses- 26,28,63,65 (virtue),Verses- 52,53,59 (dont's), Verses-71,73,75,78 (do's)

Module2 Approach to day to day work and duties. ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.

Module3 Statements of basic knowledge.ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14, 15, 16,17, 18, Personality of Role model. Shrimad BhagwadGeeta:Chapter2-Verses 17, Chapter 3-Verses 36,37,42,Chapter 4-Verses 18, 38,39,Chapter18 – Verses 37,38,63

Suggested reading

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication
2. Department), Kolkata
3. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
4. Rashtriya Sanskrit Sansthanam, New Delhi.

Open Elective

Business Analytic

Subject code:MOE01 **Credit: 03**

Unit1:

Business analytics: Overview of Business analytics, Scope of Businessanalytics, Business Analytics Process, Relationship of Business Analytics ,Process and organisation, competitive advantages of Business Analytics.Statistical Tools: Statistical Notation, Descriptive Statistical methods,Review of probability distribution and data modelling, sampling andestimation methods overview.

Unit 2:

Trendiness and Regression Analysis: Modelling Relationships and Trends inData, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models forBusiness analytics, problem solving, Visualizing and Exploring Data,Business Analytics Technology.

Unit 3:

Organization Structures of Business analytics, Team management,Management Issues, Designing Information Policy, Outsourcing, EnsuringData Quality, Measuring contribution of Business analytics, ManagingChanges.Descriptive Analytics, predictive analytics, predicative Modelling, Predictiveanalytics analysis, Data Mining, Data Mining Methodologies, Prescriptive
analytics and its step in the business analytics Process, PrescriptiveModelling, nonlinear Optimization.

Unit 4:

Forecasting Techniques: Qualitative and Judgmental Forecasting, StatisticalForecasting Models, Forecasting Models for Stationary Time Series,Forecasting Models for Time Series with a Linear Trend, Forecasting TimeSeries with Seasonality, Regression Forecasting with Casual Variables,Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation UsingAnalytic Solver Platform, New-Product Development Model, NewsvendorModel, Overbooking Model, Cash Budget Model.

Unit 5:

Decision Analysis: Formulating Decision Problems, Decision Strategies withthe without Outcome Probabilities, Decision Trees, The Value ofInformation, Utility and Decision Making.

Unit 6:

Recent Trends in : Embedded and collaborative business intelligence, Visualdata recovery, Data Storytelling and Data journalism.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Industrial Safety

Subject code:MOE02

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards,types, causes and preventive steps/procedure, describe salient points of factories act 1948 for healthand safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc,Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance,Types and applications of tools used for maintenance, Maintenance cost & its relation with replacementeconomy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problemsin machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any onemachine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors,Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventivemaintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Programand schedule of preventive maintenance of mechanical and electrical equipment, advantages ofpreventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Operations Research

Subject code:MOE03

Unit 1:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplexmethod - sensitivity analysis - parametric programming

Unit 3:
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Cost Management of Engineering Projects

Subject code:MOE04

Unit 1

Introduction and Overview of the Strategic Cost Management Process
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunitycost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control;Provision of data for Decision-Making.

Unit 2

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project
execution: conception to commissioning. Project execution as conglomeration of technical and nontechnicalactivities.DetailedEngineering activities. Pre project execution main clearances and
documents Project team: Role of each member. Importance Project site: Data required with significance.Projectcontracts.Types and contents. Project execution Project cost control. Bar charts and Networkdiagram. Project commissioning: mechanical and process

Unit 3

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and
Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making
problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing,Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning,Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-BasedCost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.BudgetaryControl;Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitabilitypricing decisions including transfer pricing.

Unit 4

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation
problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Composite Materials

Subject code:MOE05

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials.
Advantages and application of composites.Functional requirements of reinforcement and matrix.Effectof reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers,carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particlereinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures.Isostrain and Isostress conditions.
UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.
UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.
UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum straincriteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots;stress concentrations.
TEXT BOOKS:
1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
References:
1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Waste to Energy

Subject code:MOE06

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue,Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yieldsand application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermalheating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration ingasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixedbed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction andoperation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology andstatus - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Typesof biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban wasteto energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Code: MTC-03 **Course Name: Project Work –I**
Credit: 10 **Total Contact Hour:** 40hr

Course Objective:

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

Course Code: MTC-04 **Course Name: Project Work II & Dissertation**
Credit: 16 **Total Contact Hour:** 40hr

Course Objective:

The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EEP1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.