COURSE STRUCTURE for

M.Tech EEE for
Power Electronics & Power systems (PE&PS) Programme
(Applicable for batches admitted from 2019-2020)
### I Semester

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### Audit course 1 & 2

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.
Pre-Requisite: Power Electronics.

Course Educational Objectives:
- To understand the control principle of ac to ac conversion with suitable power semiconductor devices.
- To have the knowledge of ac to dc conversion and different ac to dc converter topologies.
- To understand the effect of operation of controlled rectifiers on p.f. and improvement of p.f. with PFC converters.
- To acquire the knowledge on dc-ac converters and to know the different control techniques of dc-ac converters.
- To know multilevel inverter configuration to improve the quality of the inverter output voltage.

UNIT– 1
Overview of Switching Devices:
Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT– 2

UNIT– 3
Power Factor Correction Converters: Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter.

UNIT– 4

UNIT– 5

Course Outcomes: At the end of the course, student will be able to
- Describe and analyze the operation of AC-DC converters.
- Analyze the operation of power factor correction converters.
- Analyze the operation of three phase inverters with PWM control.
- Study the principles of operation of multi-level inverters and their applications.
Text Books

Reference Books:
Pre-requisite: Knowledge on Power Generation Engineering, Power Transmission Engineering.

Course Educational Objectives:

- To study the unit commitment problem for economic load dispatch.
- To study the load frequency control of single area and two area systems with and without control.
- To study the effect of generation with limited energy supply.
- To study the effectiveness of interchange evaluation in interconnected power systems.

UNIT – 1
Unit commitment problem and optimal power flow solution: Unit commitment: Constraints in UCP, UC solution methods. Priority list method, introduction to Dynamic programming Approach.
Optimal power flow: OPF without inequality constraints, inequality constraints on control variables and dependent variables.

UNIT – 2
Single area Load Frequency Control: 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.

UNIT – 3
Two area Load Frequency Control: Load frequency control of two-area system, uncontrolled case and controlled case, tie-line bias control, steady state representation. Optimal two-area LF control- performance Index and optimal parameter adjustment. Load frequency control and Economic dispatch control.

UNIT – 4
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 – 5
Interchange Evaluation and Power Pools Economy Interchange: Economy interchange Evaluation, Interchange Evaluation with unit commitment, Multiple Interchange transactions, Other types of Interchange, power pools, transmission effects and issues.
Course Outcomes: At the end of the course, student will be able to
- Determine the unit commitment problem for economic load dispatch.
- Get the knowledge of load frequency control of single area system with and without control.
- Get the knowledge of load frequency control of two area system with and without control.
- Know the effect of generation with limited energy supply.
- Determine the interchange evaluation in interconnected power systems.

Text Books:


Reference Books:

I-semester | Control & Integration of Renewable Energy Systems (Elective -I) | Category | L-T-P | Credits
---|---|---|---|---
Pre-requisite: Power Electronics

Course Educational Objectives:
- To understand different conventional & non-conventional dynamic energy conversion technologies.
- To learn the principles of static energy conversion technologies.
- To understand the basics of real & reactive power control with renewable generators.
- To learn the principles of standalone and grid connected systems.

UNIT-1
**Introduction:** Electric grid introduction, Supply guarantee and power quality, Stability, Effects of renewable energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns, static and dynamic energy conversion technologies, interfacing requirements.

UNIT-2
**Dynamic Energy Conversion Technologies:** Introduction to different conventional and nonconventional dynamic generation technologies, principle of operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies, control and integrated operation of different dynamic energy conversion devices.

UNIT-3
**Static Energy Conversion Technologies:** Introduction to different conventional and nonconventional static generation technologies, principle of operation and analysis of fuel cell, photovoltaic based generators, and wind based generation technologies, different storage technologies such as batteries, fly wheels and ultra-capacitors, plug-in-hybrid vehicles, control and integrated operation of different static energy conversion devices.

UNIT-4
**Real and reactive power control:** Control issues and challenges in Diesel, PV, wind and fuel cell based generators, PLL, Modulation Techniques, Dimensioning of filters, Linear and nonlinear controllers, predictive controllers and adaptive controllers, Fault-ride through Capabilities, Load frequency and Voltage Control.

UNIT-5
**Integration of different Energy Conversion Technologies:** Resources evaluation and needs, Dimensioning integration systems, Optimized integrated systems, Interfacing requirements, integrated Control of different resources, Distributed versus Centralized Control, Synchro Converters, Grid connected and Islanding Operations, stability and protection issues, load sharing, Cases studies

Course Outcomes: After the completion of the course, student will be able to
- Gain knowledge on different renewable energy sources and storage devices
- Recognize, model and simulate different renewable energy sources
- Analyze, model and simulate basic control strategies required for grid connection
- Implement a complete system for standalone/grid connected system
Text books:

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**Pre-requisite:** Signals & Systems

**Course Educational Objectives:**

- To understand the various digital filter structures
- To design the FIR and IIR Filters
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform
- To analyze the finite word length effects on various filters
- To learn the power spectrum estimation of periodic and non-periodic signals

**UNIT– 1**

**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.

**UNIT– 2**

**Digital filter design:** Preliminary considerations-Bilinear transformation method of IIR filter design-design of lowpass, high pass-band pass, and band stop- IIR digital filters-Spectral transformations of IIR filters, FIR filter design-based on windowed Fourier series- design of FIR digital filters with least –mean-square-error-constrained least-square design of FIR digital filters

**UNIT– 3**

**DSP algorithm implementation:** Computation of the discrete Fourier transform- number representation-arithmetic operations handling of overflow-tunable digital filters-function approximation.

**UNIT– 4**


**UNIT– 5**


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

- Describe structure of digital filters.
- Design digital filters with different techniques.
- Understand the implementation aspects of signal processing algorithms.
- Know the effect of finite word length in signal processing.
- Analyze different power spectrum estimation techniques.
Text Books:

Reference Books:
4. Digital Filter Analysis and Design-Auntonian-TMH.
Pre requisite: Knowledge on electric circuit analysis, power systems and power electronics and concept of reactive power compensation techniques.

Course Educational Objectives:

- To understand significance of power quality and power quality parameters.
- To know types of transient over voltages and protection of transient voltages.
- To understand harmonics, their effects, harmonic indices and harmonic minimization techniques.
- To understand the importance of power devices and their applications.
- To understand different compensation techniques to minimize power quality disturbances.

UNIT– 1
Introduction to power quality: Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT– 2

UNIT– 3

UNIT– 4
Custom Power Devices: Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT– 5
Application of custom power devices in power systems: Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic Voltage Restorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and control of Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner
Course Outcomes: At the end of the course, student will be able to

- Identify the issues related to power quality in power systems.
- Address the problems of transient and long duration voltage variations in power systems.
- Analyze the effects of harmonics and study of different mitigation techniques.
- Identify the importance of custom power devices and their applications.
- Acquire knowledge on different compensation techniques to minimize power quality disturbances.

Text Books:


Reference Books:

6. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S. Masoum-Elsevier
Pre-requisite: Knowledge on basics of distribution systems, Compensation in electrical distribution systems, Circuit Analysis, concept of load modeling.

Course Educational Objectives:

- To learn the importance of economic distribution of electrical energy.
- To analyze the distribution networks for V-drops, \( P_{\text{Loss}} \) calculations and reactive power.
- To understand the co-ordination of protection devices.
- To impart knowledge of capacitive compensation/voltage control.
- To understand the principles of voltage control.

UNIT – 1
General: Introduction to Distribution systems, an overview of the role of computers in distribution system planning-Load modelling 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.

UNIT – 2
Distribution Feeders and Substations: Design consideration of Distribution feeders: Radial and loop types of primary feeders, voltage levels, and feeder-loading. Design practice of the secondary distribution system. Location of Substations: Rating of a Distribution Substation, service area with ‘n’ primary feeders. Benefits derived through optimal location of substations.

UNIT – 3

UNIT – 4
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.

UNIT – 5
Distribution automation functions: Electrical system automation, EMS functional scope, DMS functional scope functionality of DMS- Steady state and dynamic performance improvement; Geographic information systems-AM/FM functions and Database management; communication options, supervisory control and data acquisition: SCADA functions and system architecture; Synchrophasors and its application in power systems.
Course Outcomes: At the end of the course, student will be able to

- Analyze a distribution system.
- Design equipment for distribution system and sub-stations.
- Design protective systems and co-ordinate the devices.
- Understand of capacitive compensation.
- Understand of distribution automation.

Text Books:


Reference Books:

2. Electrical Distribution V. Kamaraju-McGraw Hill
**I-Semester** | **HVDC Transmission**  
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**Prerequisites:** Knowledge on Power Electronics, Power Systems and High Voltage Engineering

**Course Educational Objectives:**
- To learn various schemes of HVDC transmission.
- To learn about the basic HVDC transmission equipment.
- To learn the control of HVDC systems.
- To be exposed to the interaction between HVAC and HVDC system.
- To be exposed to the various protection schemes of HVDC engineering.

**UNIT – 1**
Limitation of EHV AC Transmission, Advantages of HVDC: Technical economical and reliability aspects. HVDC Transmission: General considerations, Power Handling Capabilities of HVDC Lines, Basic Conversion principles, static converter configuration. Types of HVDC links-Apparatus and its purpose

**UNIT – 2**
Static Power Converters: 6-pulse bridge circuit and 12-pulse converters, converter station and Terminal equipment, commutation process, Rectifier and inverter operation, equivalent circuit for converter – special features of converter transformers. Comparison of the performance of diametrical connection with 6-pulse bridge circuit

**UNIT – 3**
Control of HVDC Converters and systems: constant current, constant extinction angle and constant Ignition angle control. Individual phase control and equidistant firing angle control, DC power flow control. Factors responsible for generation of Harmonics voltage and current, harmonics effect of variation of $\alpha$ and $\mu$. Filters, Harmonic elimination.

**UNIT – 4**
Interaction between HV AC and DC systems – Voltage interaction, Harmonic instability problems and DC power modulation. Development of DC circuit Breakers, Multi-terminal DC links and systems; series, parallel and series parallel systems, their operation and control.

**UNIT – 5**
Transient over voltages in HV DC systems: Over voltages due to disturbances on DC side, over voltages due to DC and AC side line faults. Converter faults and protection in HVDC Systems: Converter faults, over current protection - valve group, and DC line protection, circuit breakers. Over voltage protection of converters, surge arrester.

**Course Outcomes:** At the end of the course, student will be able to
- Understand the various schemes of HVDC transmission.
- Understand the basic HVDC transmission equipment.
- Understand the control of HVDC systems.
- Understand the interaction between HVAC and HVDC system.
- Understand the various protection schemes of HVDC engineering.
- Understand the various schemes of HVDC transmission.
Text Books:

Reference Books:
**Course Educational Objectives:**

- To learn about classification and operation of static relays.
- To understand the basic principles and application of comparators.
- To learn about static version of different types of relays.
- To understand about numerical protection techniques.

**UNIT – 1**

**UNIT – 2**
Phase Comparison: Block Spike and phase Splitting Techniques – Transistor Integrating type, phase comparison, Rectifier Bridge Type Comparison – Vector product devices.

**UNIT – 3**
Static over current (OC) relays – Instantaneous, Definite time, Inverse time OC Relays, static distance relays, static directional relays, static differential relays, measurement of sequence impedances in distance relays, multi input comparators, elliptic & hyperbolic characteristics, switched distance schemes, Impedance characteristics during Faults and Power Swings,

**UNIT – 4**

**UNIT – 5**
Numerical Protection: Introduction - numerical relay - numerical relaying algorithms - mann-morrison technique - Differential equation technique and discrete fourier transform technique - numerical over current protection - numerical distance protection.
Course Outcomes: At the end of the course, student will be able to

- Know the classifications and applications of static relays.
- Understand the application of comparators.
- Understand the static version of different types of relays.
- Understand the numerical protection techniques.

Text Books:
1. Power System Protection with Static Relays – by TSM Rao, TMH.
2. Power system protection & switchgear by Badri Ram & D N viswakarma, TMH.

Reference Books:
1. Protective Relaying Vol-II Warrington, Springer.
4. Electrical Power System Protection –C.Christopoulos and A.Wright- Springer
5. Protection & Switchgear –BhaveshBhalaja, R.PMaheshwari, NileshG.Chothani-Oxford
   publisher
UNIT-I
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III

UNIT-IV

UNIT-V
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
<table>
<thead>
<tr>
<th>I-Semester</th>
<th>Power Electronics Simulation Laboratory</th>
<th>Category</th>
<th>L-T-P</th>
<th>Credits</th>
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**Course Educational Objectives:**
To analyze the operation of DC-DC converters, AC-DC converters and DC-AC converters by simulation.

**List of Experiments:**
1. Simulation of Buck converter using small signal model.
2. Simulation of Boost converter using small signal model.
3. Simulation of single phase half bridge inverter.
4. Simulation of full bridge inverter using Uni-polar & Bi-polar PWM techniques.
5. Simulation of three phase inverter using sine-triangle PWM.
6. Simulation of three phase inverter using space vector PWM.
7. Simulation of three level three phase NPC inverter.
8. Study of neutral point voltage floating in NPC three level inverter.
9. Simulation of 3-level flying capacitor inverter & evaluation of capacitor voltage balanced methods.
10. Simulation of single phase AC voltage regulator.
11. Simulation of three phase AC voltage regulator.
12. Comparison of harmonic profile of two level & three level inverter (FFT analysis).
13. Simulation of 5-level inverter using carrier based PWM methods.
15. Simulation of three-phase dual converter.

**Course Outcome:** To understand the operation of DC-DC converters, AC-DC converters, AC voltage regulators and DC-AC converters by simulation.
<table>
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<tr>
<th>I-Semester</th>
<th>Power Systems Laboratory</th>
<th>Category</th>
<th>L-T-P</th>
<th>Credits</th>
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**Course Educational Objectives:**
To understand the experimental determination of various parameters used in power system area and to analyze the performance of transmission line with and without compensation.

**List of Experiments:**

1. Determination of Sequence Impedance of an Alternator by direct method.
2. Determination of Sequence impedance of an Alternator by fault Analysis.
3. Measurement of sequence impedance of a three phase transformer
   (a). by application of sequence voltage. (b). using fault analysis.
5. Poly-phase connection on three single phase transformers and measurement of phase displacement.
7. Measurement of ABCD parameters on transmission line model.
9. Study of Ferranti effect in long transmission line.

**Course Outcomes:**
After the Completion of lab they will understand procedure for determination of various parameters used in power system as well as performance of transmission line.
II-semester | Switched Mode Power Conversion | Category | L-T-P | Credits
---|---|---|---|---

Pre-requisite: Concepts of electrical circuit analysis and power electronics.

Course Educational Objectives:
- To understand the control operation of non-sinusoidal DC-DC converters.
- To understand the basic operation of resonant converters.
- To understand the control operation of isolated DC-DC converters.
- To understand the control schemes of DC-DC converters and designing of magnetic components.
- To understand the modeling and control design of switch mode conversion based on linearization.
- To understand how to analyze the switch mode converters using small-signal analysis.

UNIT– 1
Non-isolated switch mode converters:
Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converter, CUK Converter, continuous and discontinuous operation, Converter realization with non-ideal components.

UNIT– 2
Isolated switch mode converters:
Forwarded converter, flyback converter, push-pull converter, half-bridge converter, full bridge converter.

UNIT– 3
Resonant converters:

UNIT– 4
Control schemes of switching converters:
Voltage control, Current mode control, control scheme for resonant converters.
Magnetic design consideration: Transformer design, inductor and capacitor design.

UNIT– 5
Modeling and Controller design based on linearization:
Formulation of averaged models for buck and boost converters: state space analysis, average circuit models, linearization and small – signal analysis, small-signal models.
Control design based on linearization: Transfer function of converters, control design, large signal issues in voltage-mode and current-mode control.

Course Outcomes: At the end of the course, student will be able to
- Analyze operation and control of non-isolated and isolated switch mode converters.
- Design of non-isolated and isolated switch mode converters.
- Analyze operation and control of resonant converters.
- Feedback design of switch mode converters based on linearized models.
Text Books:

Reference Books:
II-Semester | Real Time Control of Power Systems | Category | L-T-P | Credits
--- | --- | --- | --- | ---
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Pre-requisite: Power system operation and control.

**Course Educational Objectives:**

- To understand the importance of state estimation in power systems.
- To know the importance of security and contingency analysis.
- To understand SCADA, its objectives and its importance in power systems.
- To know the significance of voltage stability analysis.
- To know the applications of AI to power systems problems.

**UNIT – 1:**
State Estimation: Different types of State Estimations, Theory of WLS state estimation, sequential and non-sequential methods to process measurements. Bad data Observability, Bad data detection, identification and elimination.

**UNIT – 2:**

**UNIT – 3:**
Computer Control of Power Systems: Need for real time and computer control of power systems, operating states of a power system, SCADA - Supervisory control and Data Acquisition systems implementation considerations, energy control centers, software requirements for implementing the above functions.

**UNIT – 4:**

**UNIT – 5:**
Synchrophasor Measurement units: Introduction, Phasor representation of sinusoids, a generic PMU, GPS, Phasor measurement systems, Communication options for PMUs, Functional requirements of PMUs and PDCs, Phasors for nominal frequency signals, types of frequency excursions in power systems, DFT estimation at off nominal frequency with a nominal frequency clock.
Course Outcomes: At the end of the course, student will be able to
- Understand state estimation, security and contingency evaluation.
- Understand about Supervisory control and data acquisition.
- Real time software application to state estimation.
- Understand application of AI in power system.

Text Books:


Reference Books:

II- Semester | Electrical Machine Modeling and Analysis (Elective –III) | Category | L-T-P | Credits |
|-------------|--------------------------------------------------|----------|-------|--------|

Pre-requisite: Electrical machines & Special machines.

Course Educational Objectives:
- To know the concepts of generalized theory of electrical machines.
- To represent the DC and AC machines as Basic Two Pole machine.
- To model the electrical machines with voltage, current, torque and speed equations.
- To investigate the steady state and transient behavior of the electrical machines.
- To understand the dynamic behavior of the AC machines.

UNIT– 1
Basic concepts of Modeling
Basic two-pole machine representation of Commutator machines, representations of 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron’s primitive Machine voltage, current and torque equations.

UNIT– 2
DC Machine Modeling

UNIT– 3
Reference frame theory & Modeling of single phase Induction Machines
Linear transformation-Phase transformation - three phase to two phase transformation (abc to α β 0) and vice-versa, transformation to rotating reference frame, (α β 0 to dqo) and vice versa -Power equivalence-Mathematical modeling of single phase induction machines.

UNIT– 4
Modeling of three phase Induction Machine
Generalized model in arbitrary reference frame-Derivation of commonly used induction machine models-Synchronously rotating reference frame model, Stator reference frame model-Rotor reference frame model-power equation, electromagnetic torque equation, state space model in induction motor with flux linkages as variables

UNIT– 5
Modeling of Synchronous Machine
Synchronous machine inductances –derivation of voltage equations in the rotor’s dq0 reference frame electromagnetic torque-current in terms of flux linkages-three phase synchronous motor. State space models with flux linkages as variables.

Course Outcomes: At the end of the course, student will be able to
• Analyze the characteristics of different types of DC motors to design suitable controllers for different applications.
• Apply the knowledge of reference frame theory for AC machines to model the induction and Synchronous machines.
• Evaluate the steady state and transient behavior of induction and synchronous machines to Propose the suitability of drives for different industrial applications
• Analyze the behavior of induction machines using voltage and torque equations.

Text Books

Reference Books:

Course Educational Objectives:
- To study DSP controllers.
- To learn coding in DSP’s to control the electric drive speed.
- To learn speed control methods for induction motor, PMSM, BLDC motors.

UNIT-1
Overview of TMS320LF2407 DSP controller: Review of Instruction Set, Interrupts, normalization and number formatting.

UNIT-2
Clarke's and Park's transformations: Review of Clarke's and Park's transformations, Implementation of Clarke's and Park's transformation using TMS320LF2407 DSP

UNIT-3
Implementation of PWM Techniques for 3-Ph VSI: Implementation of Sine-triangle and SVPWM with TMS320LF2407 DSP using the concept of imaginary switching time

UNIT-4
Control of BLDC Motor: Principle of operation with Drive control system, implementation of control system using TMS320LF2407 DSP

UNIT-5
Control of PMSM: Principle of operation with drive control system, implementation of vector control using TMS320 LF2407DSP

UNIT-6
Control of Induction Motor: Implementation of field oriented control for the speed control of Induction Motor using TMS320LF2407 DSP.

Course Outcomes: At the end of the course, student will be able to
- Interface the DSP platform with sensors such as hall-effect voltage sensors,
- Use hall-effect current sensors, shaft encoder for data acquisition for motor drive applications
- Scale and normalize the data to suit the requirements of the drive system
- Exploit the architectural features of the DSP platform to design and implement
- Use algorithms for the realization of controllers, Pulse Width Modulators and observers

Text Books:

Reference:
1. Application Notes from the website of Texas Instruments.
II-Semester | Applications of Power Converters (Elective-III) | Category | L-T-P | Credits |
|---|---|---|---|---|

Pre-requisites: Analysis of Power Electronic Converters

Course Educational Objectives:
- To understand the inverters for induction heating applications
- To understand the power converters for different industrial applications
- To understand modeling of high voltage power supplies using the power converters for radar and space applications
- To understand modeling of low voltage and high current power supplies using the power converters for microprocessors and computer loads
- To understand the applications of DC-DC converters

UNIT-1
Inverters for Induction Heating: For induction cooking, induction hardening, melting, and welding applications.

UNIT-2
Power Converters for Lighting, pumping and refrigeration Systems: Electronic ballast, LED power drivers for indoor and outdoor applications. PFC based grid fed LED drivers, PV / battery fed LED drivers. PV fed power supplies for pumping/refrigeration applications.

UNIT-3
High Voltage Power Supplies - Power supplies for X-ray applications - power supplies for radar applications - power supplies for space applications.

UNIT-4
Low voltage high current power supplies: Power converters for modern microprocessor and computer loads

UNIT-5
Bi-directional DC-DC (BDC) converters: Electric traction, automotive Electronics and charge/discharge applications, Line Conditioners and Solar Charge Controllers

Course Outcomes: At the end of the course, student will be able to
- Analyze power electronic application requirements.
- Identify suitable power converter from the available configurations.
- Develop improved power converters for any stringent application requirements.
- Improvise the existing control techniques to suit the application. Design of Bi-directional converters for charge/discharge applications

Text books:

References:
2. Current literature
Pre-requisite: Transmission line parameters and properties, Corona etc.

Course Educational Objectives:
- To calculate the transmission line parameters.
- To calculate the field effects on EHV and UHV AC lines.
- To have knowledge of corona, RI and audible noise in EHV and UHV lines.
- To have knowledge of voltage control and compensation problems in EHV and UHV transmission systems.

UNIT – 1

UNIT – 2
Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.

UNIT – 3
Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.

UNIT – 4
Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines

UNIT – 5
Reactive power compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system.
Course Outcomes: At the end of the course, student will be able to
- Calculate the transmission line parameters.
- Calculate the field effects on EHV and UHV AC lines.
- Determine the corona, RI and audible noise in EHV and UHV lines.
- Analyze voltage control and compensation problems in EHV and UHV transmission systems.
- Understand reactive power compensation using SVC and TCR

Text Books:

Pre-requisite: Concepts on Power Electronics and Power Systems

Course Educational Objectives:

- To study the performance improvements of transmission system with FACTS.
- To study the effect of static shunt compensation.
- To study the effect of static series compensation.
- To study the effect of UPFC.

UNIT – 1
FACTS concepts, Transmission interconnections, power flow in an AC System, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

UNIT – 2
Basic concept of voltage and current source converters, comparison of current source converters with voltage source converters.
Static shunt compensation: Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable VAr generation, variable impedance type static VAr generation, switching converter type VAr generation, hybrid VAr generation.

UNIT – 3
SVC and STATCOM: The regulation slope, transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.

UNIT – 4
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.

UNIT – 5
Unified Power Flow Controller: Basic operating principle, conventional transmission control capabilities, independent real and reactive power flow control, comparison of the UPFC to series compensators and phase angle regulators. Introduction to Inter line Power Flow Controller (IPFC)

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

- Know the performance improvement of transmission system with FACTS.
- Get the knowledge of effect of static shunt and series compensation.
- Know the principle of operation and various controls of UPFC
- Determine an appropriate FACTS device for different types of applications.
Text Books:
   Indian Edition is available:--Standard Publications

Reference Books:
2. HVDC & FACTS Controllers: applications of static converters in power systems-
   Vijay K.Sood- Springer publishers
Pre-requisite: Knowledge of synchronous machine, Power System Analysis

Course Educational Objectives:

- To study the model of synchronous machines.
- To study the stability studies of synchronous machines.
- To study the solution method of transient stability.
- To study the effect of different excitation systems.

UNIT – 1
System Dynamics: Synchronous machine model in state space from computer representation for excitation and governor system – modeling of loads and induction machines.

UNIT – 2

UNIT – 3

UNIT – 4
Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability.

UNIT – 5
Excitation Systems: Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme – Brushless excitation system.

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

- Determine the model of synchronous machines.
- Know the stability studies of synchronous machines.
- Get the knowledge of solution methods of transient stability.
- Know the effect of different excitation systems in power systems.

Text Books:

Reference Books:
1. Power systems stability and control by PRABHA KUNDUR, TMH.
II-Semester | Power Converters Laboratory | Category | L-T-P | Credits |
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Course Educational Objectives:
To study and understand the different converters and inverters for single and three phase loads.

Any 10 of the following experiments are to be conducted.

List of experiments

1. Study of DC-DC non-isolated converters such as Buck & Boost converter.
2. Study of DC-DC Buck - Boost and Cuk converters.
3. Study of 1-ϕ dual converter.
4. Determination of input p.f. and harmonic factor for 1-ϕ semi- converter and 1- ϕ full-converter (Inductive load)
5. Study of p.f. improvement in 1-ϕ full-converter with symmetric and extinction angle control.
6. Study of 1-ϕ square wave and sinusoidal PWM inverter.
7. Study of 3-ϕ inverter with 120° and 180° mode of operation.
8. Study of 3-ϕ sinusoidal PWM inverter.
9. Study of 3-level NPC inverter.
10. Study of 5-level cascaded H-bridge inverter.
13. Study the characteristics of IGBT, MOSFET & GTO’s.
14. Design of gate drive circuits for IGBT & MOSFET’s.

Course Outcomes: Students are able to implement the converter and inverters in real time applications.
II-Semester | Power Systems Simulation Laboratory | Category | L-T-P | CREDITS
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Pre-requisite: Electrical Power Systems

Course Educational Objectives:
- To understand the modelling of different transmission lines
- To understand the mathematical formulation of distribution system load flow
- To understand the formation of Z- and Y-bus matrices
- To understand load low analysis using GS and NR methods
- To understand the symmetrical & unsymmetrical fault analysis using Z-bus
- To understand the transient stability analysis and load frequency control problem

Any 10 of the following experiments are to be conducted.

List of Experiments:

1. Performance analysis of short, medium and long transmission lines
2. Distribution load flow analysis
3. Economic Load Dispatch with & without transmission losses
4. Formation of Y-bus by direct inspection method
5. Formations of Z-bus by building algorithm
7. Load Flow Solution Using Newton Raphson Method
8. Symmetrical and Unsymmetrical Fault analysis using Z-bus
10. Transient Stability Analysis using modified R-K method
11. Transient Stability Analysis Using Point By Point Method
12. Load Frequency Control of Single Area Control & Two Area Control system with and without controllers.

Course Outcomes: The student shall be able to

1. Analyze the performance of the various transmission lines at different loading conditions
2. Perform the load flow study on distribution systems
3. Form the Z- and Y-bus matrices for the given power transmission system
4. Analyze the load flow solution obtained using GS and NR methods
5. Analyze the transient stability and load frequency control problem of a power system
II-Semester | Mini Project with Seminar | Category | L-T-P | Credits
---|---|---|---|---

**Note:**
It is recommended that a Supervisor/advisor should be allotted to each student at the end of the semester-I or allot at the start of the semester-II

**Syllabus content:**

A Student has to select one paper published in any of the IEEE Transactions and simulate the same. The student has to present the progress of the work at the middle of the semester. At the end of the semester, the student has to present the results by explaining the idea of the topic, methodology, finding of the simulations. A Student should also submit a report of the entire work carried out under this course. The end semester presentation must be video recorded and preserved.
### Course Educational Objectives:
- To understand the concept of hybrid vehicles, types of electric drives used in hybrid vehicles and their control

**UNIT– 1**
**Introduction:**
History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.

**UNIT– 2**
**Hybridization of Automobile:**
Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

**UNIT– 3**
**Plug-in Hybrid Electric Vehicle:**
PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

**UNIT– 4**
**Power Electronics in HEVs:**
Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

**UNIT– 5**
**Battery and Storage Systems**
Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

**Course Outcomes:** At the end of the course, student will be able to
- Know the concept of electric vehicles and hybrid electric vehicles.
- Familiar with different motors used for hybrid electric vehicles.
- Understand the power converters used in hybrid electric vehicles
- Know different batteries and other energy storage systems.

**Text Books**
Reference Books:
<table>
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<tr>
<th>III Semester</th>
<th>Optimization Techniques (Elective-II)</th>
<th>Category</th>
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**Prerequisites:** Concepts of engineering mathematics and mathematical methods.

**Course Educational Objectives:**
- To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- To state single variable and multi variable optimization problems, without and with constraints.
- To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
- To introduce evolutionary programming techniques.
- To introduce basic principles of Genetic Algorithms and Partial Swarm Optimization methods.

**UNIT – I:**
**Introduction and Classical Optimization Techniques:**

**UNIT – II:**
**Linear Programming**

**UNIT – III:**
**Nonlinear Programming:**
**Unconstrained cases** - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell’s method and steepest descent method.
Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

UNIT – IV:
Introduction to Evolutionary Methods:
Evolutionary programming methods - Introduction to Genetic Algorithms (GA)– Control parameters –Number of generation, population size, selection, reproduction, crossover and mutation – Operator selection criteria – Simple mapping of objective function to fitness function – constraints – Genetic algorithm steps – Stopping criteria –Simple examples.

UNIT – V:
Introduction to Swarm Intelligence Systems:
Swarm intelligence programming methods - Basic Partial Swarm Optimization – Method – Characteristic features of PSO procedure of the global version – Parameters of PSO (Simple PSO algorithm – Operators selection criteria – Fitness function constraints) – Comparison with other evolutionary techniques – Engineering applications of PSO.

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

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.
- Able to apply Genetic algorithms for simple electrical problems.
- Able to solve practical problems using PSO.

Text Books

Reference Books:
Pre-requisite: Fundamentals of Neural networks and Fuzzy Logic.

Course Educational Objectives:
- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

UNIT– 1
Introduction

UNIT– 2
ANN Paradigms
ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen’s self organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT– 3
Classical and Fuzzy Sets
Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT– 4
FUZZY LOGIC CONTROLLER (FLC)
Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets- Defuzzification methods.

UNIT– 5
Application of AI Techniques
Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

Course Outcomes: At the end of the course, student will be able to
- Differentiate between Algorithmic based methods and knowledge based methods.
- Use appropriate AI framework for solving power system problems.
- To design fuzzy logic controllers for power engineering applications.

Text Books:
Reference Books:

4. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa
   TMGH
5. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam, S Sumathi, S N Deepa
III-Semester | Energy Audit Conservation & Management (Open Elective) | Category | L-T-P | Credits
---|---|---|---|---

Pre-requisite: Electrical power systems and measurements.

Course Educational Objectives:
- To learn the basics of energy audit and energy conservation schemes.
- To comprehend the principles of energy management and understand the need of energy efficient motors and lighting design practices.
- To learn about power factor improvement techniques and energy instruments.
- To learn about the economic aspects of energy equipment.

UNIT– 1
Basic Principles of Energy Audit
Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT– 2
Energy Management
Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language, Questionnaire – check list for top management

UNIT– 3
Energy Efficient Motors and Lighting
Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, variable duty cycle systems, RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit

UNIT– 4
Power Factor Improvement and energy instruments
Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers, application of PLC’s

UNIT– 5
Economic Aspects and their computation
Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Course Outcomes: At the end of the course, student will be able to
- Understand the principle of energy audit and their economic aspects.
- Recommend energy efficient motors and design good lighting system.
- Understand advantages to improve the power factor.
- Evaluate the depreciation of equipment.
Text Books:

Reference Books:
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO
III Semester | Operations Research (Open Elective) | Category | L-T-P | Credits
---|---|---|---|---

Pre-requisite: Engineering Mathematics

Course Educational Objectives:
- To learn mathematical modeling of physical systems and its solving techniques with and without constraints.
- To understand the solving of LPP problem using graphical and simplex method.
- To understand the solving of non-linear programming problem.
- To understand the scheduling and sequencing problem of different models with geometric programming.
- To understand the solving of LPP using dynamic programming and graph theory.

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 simplex method - 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

Course Outcomes: At the end of the course, the student should be able to
- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real world problem and simulate it.

Reference Books:
Pre-requisite: MEFA & Management Science

Course Educational Objectives:
- To learn cost concepts in decision making
- To learn different stages and aspects of a project and execution
- To learn resources planning, quality management.
- To learn application of techniques such as linear programming, PERT/CPM
- To learn profit planning and budgeting

Unit 1: Introduction and Overview of the Strategic Cost Management Process

Unit 2: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit 3: Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process


Course Outcomes: At the end of the course, students should be able to
- Understand the cost management process and various costs involved in a project
- Analyze various aspects of a project like project site, project team, contracts, execution and commissioning
- Perform various costing and cost management and cost management, profit planning
- Apply linear programming PERT/CPM to cost management
Reference Books:
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
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
<table>
<thead>
<tr>
<th>III SEMESTER</th>
<th>DISSERTATION PHASE-I</th>
<th>CATEGORY</th>
<th>L-T-P</th>
<th>CREDIT</th>
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<tr>
<td>IV SEMESTER</td>
<td>DISSERTATION PHASE-II</td>
<td>CATEGORY</td>
<td>L-T-P</td>
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<td>0-0-32</td>
<td>16</td>
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</table>
**Course objectives:**
Students will be able to:
Understand that how to improve your writing skills and level of readability
Learn about what to write in each section
Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

**Syllabus**

<table>
<thead>
<tr>
<th>Units</th>
<th>CONTENTS</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.</td>
<td>4</td>
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<tr>
<td>4</td>
<td>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,</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions</td>
<td>4</td>
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<tr>
<td>6</td>
<td>useful phrases, how to ensure paper is as good as it could possibly be the first-time submission</td>
<td>4</td>
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</table>

**Suggested Studies:**
**Course Objectives:** Students will be able to:

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

### Syllabus

<table>
<thead>
<tr>
<th>Units</th>
<th>CONTENTS</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Introduction</strong>&lt;br&gt;Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td><strong>Repercussions Of Disasters And Hazards:</strong> Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.&lt;br&gt;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.</td>
<td>4</td>
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<tr>
<td>3</td>
<td><strong>Disaster Prone Areas In India</strong>&lt;br&gt;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</td>
<td>4</td>
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<tr>
<td>4</td>
<td><strong>Disaster Preparedness And Management</strong>&lt;br&gt;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.</td>
<td>4</td>
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<tr>
<td>5</td>
<td><strong>Risk Assessment</strong>&lt;br&gt;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.</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td><strong>Disaster Mitigation</strong>&lt;br&gt;Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.</td>
<td>4</td>
</tr>
</tbody>
</table>
Suggested Readings:
2. Sahni, PardeepEt.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
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<tbody>
<tr>
<td>1</td>
<td>• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>• Order • Introduction of roots • Technical information about Sanskrit Literature</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics</td>
<td>8</td>
</tr>
</tbody>
</table>

Suggested reading

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood

Being a logical language will help to develop logic in
AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives
5. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
6. Learning of Sanskrit to improve brain functioning
7. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
8. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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</thead>
</table>
| 1    | • Alphabets in Sanskrit,  
      • Past/Present/Future Tense,  
      • Simple Sentences | 8 |
| 2    | • Order  
      • Introduction of roots  
      • Technical information about Sanskrit Literature | 8 |
| 3    | • Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics | 8 |

Suggested reading
5. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbhashatri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

Course Output
Students will be able to
1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students
Course Objectives
Students will be able to
1. Understand value of education and self-development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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</thead>
</table>
| 1    | • Values and self-development – Social values and individual attitudes. Work ethics, Indian vision of humanism.  
     • Moral and non-moral valuation. Standards and principles.  
     • Value judgements                                             | 4     |
| 2    | • 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                    | 6     |
| 3    | • Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. 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                                | 6     |
| 4    | • 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                               | 6     |

Suggested reading

Course outcomes
Students will be able to 1. Knowledge of self-development
AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:
Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

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<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>1</td>
<td>• History of Making of the Indian Constitution: History Drafting Committee, (Composition &amp; Working)</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>• Philosophy of the Indian Constitution: Preamble Salient Features</td>
<td>4</td>
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</tbody>
</table>
**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

**Local Administration:**
- District’s Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
- Elected officials and their roles, CEO ZilaPanchayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

**Election 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.

**Course Outcomes:**
Students will be able to:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of
AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:
Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.

5. Identify critical evidence gaps to guide the development.

Syllabus

<table>
<thead>
<tr>
<th>Units</th>
<th>Content</th>
<th>Hours</th>
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</thead>
</table>
| 1     | **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.  | 4     |
| 2     | • Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.  
|       | • Curriculum, Teacher education.          | 2     |
| 3     | • 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.                      | 4     |
|       | • Strength and nature of the body of evidence for effective pedagogical practices.  
|       | • Pedagogic theory and pedagogical approaches.  
|       | • Teachers’ attitudes and beliefs and Pedagogic strategies.         |       |
| 4     | • 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  | 4     |
| 5     | **Research gaps and future directions**  
|       | • Research design  
|       | • Contexts  
|       | • Pedagogy  
|       | • Teacher education  
|       | • Curriculum and assessment  
|       | • Dissemination and research impact.     | 2     |
Suggested reading

Course Outcomes:
Students will be able to understand:
1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives
1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

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<tr>
<th>Unit</th>
<th>Content</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Definitions of Eight parts of yog. (Ashtanga)</td>
<td>8</td>
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<tr>
<td>2</td>
<td>Yam and Niyam. Do’s and Don’t’s in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Asan and Pranayam 1. Various yog poses and their benefits for mind &amp; body 2. Regularization of breathing techniques and its effects-Types of pranayam</td>
<td>8</td>
</tr>
</tbody>
</table>

Suggested reading
1. ‘Yogic Asanas for Group Tarining-Part-I’ : Janardan Swami YogabhyasiMandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:
Students will be able to:
1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency
AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives
1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

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<tr>
<th>Unit</th>
<th>Content</th>
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<tbody>
<tr>
<td>1</td>
<td>Neetisatakam-Holistic development of personality</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>• Verses- 19,20,21,22 (wisdom)</td>
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<td>• Verses- 29,31,32 (pride &amp; heroism)</td>
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<td></td>
<td>• Verses- 26,28,63,65 (virtue)</td>
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<td>• Verses- 52,53,59 (don’ts)</td>
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<tr>
<td></td>
<td>• Verses- 71,73,75,78 (do’s)</td>
<td></td>
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<tr>
<td>2</td>
<td>• Approach to day to day work and duties.</td>
<td>8</td>
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<tr>
<td></td>
<td>• Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,</td>
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<td></td>
<td>• Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,</td>
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<td>• Chapter 18-Verses 45, 46, 48.</td>
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<tr>
<td>3</td>
<td>• Statements of basic knowledge.</td>
<td>8</td>
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<td>• Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68</td>
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<td></td>
<td>• Chapter 12 -Verses 13, 14, 15, 16,17, 18</td>
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<td></td>
<td>• Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17,</td>
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<td></td>
<td>• Chapter 3-Verses 36,37,42,</td>
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<td></td>
<td>• Chapter 4-Verses 18, 38,39</td>
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<tr>
<td></td>
<td>• Chapter 18 – Verses 37,38,63</td>
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</tbody>
</table>

Suggested reading
1. “Srimad Bhagavad Gita” by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes
Students will be able to
1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
Study of Neetishatakam will help in developing versatile personality of students