Indira Gandhi University, Meerpur, Rewari

NEW SCHEME OF STUDIES AND EXAMINATION
(w.e.f. 2021-22)
B-TECH 4th YEAR (ELECTRICAL ENGINEERING)
SEMESTER-VII

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Teaching Schedule</th>
<th>Examination Schedule (Marks)</th>
<th>Credit</th>
<th>Duration of Exam (Hours)</th>
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<td>Theory</td>
<td>Practical</td>
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<td>Evaluation of Summer Internship</td>
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Note: 1. The evaluation of Summer Internship will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded ‘F’ grade is required to repeat.
2. Choose any one subject from TABLE-I
3. Choose any one subject from TABLE-II
4. Choose any one subject from TABLE-III
5. Choose any one subject from TABLE-IV
6. Choose any one subject from TABLE-V

TABLE-1
PROGRAM ELECTIVE LIST (Program Elective -IV)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
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<tbody>
<tr>
<td>1.</td>
<td>PEC-EE-401</td>
<td>Power management</td>
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<tr>
<td>2.</td>
<td>PEC-EE-403</td>
<td>Electrical Engineering Drawing</td>
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<td>3.</td>
<td>PEC-EE-405</td>
<td>Utilization of Electrical Power</td>
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<td>PEC-EE-407</td>
<td>Advanced Power Electronics</td>
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<td>5.</td>
<td>PEC-EE-409</td>
<td>Power System Planning and Reliability</td>
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### TABLE-II
**PROGRAM ELECTIVE LIST (Program Elective -V)**

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<tbody>
<tr>
<td>1.</td>
<td>PEC-EE-411</td>
<td>Modelling and Analysis of Electrical Machines</td>
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<tr>
<td>2.</td>
<td>PEC-EE-413</td>
<td>Microcontroller Based System Design</td>
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<td>3.</td>
<td>PEC-EE-415</td>
<td>Advanced Power Transmission</td>
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<td>4.</td>
<td>PEC-EE-417</td>
<td>Computer Aided Power System Analysis</td>
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### TABLE-III
**PROGRAM ELECTIVE LIST FOR VII SEM (Program Elective –VI)**

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<td>1.</td>
<td>PEC-EE-402</td>
<td>Special Electrical Machines</td>
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<td>2.</td>
<td>PEC-EE-404</td>
<td>Applications of Power Electronics in Power Systems</td>
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<td>PEC-EE-406</td>
<td>Power System Stability</td>
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<td>Advanced Control Systems</td>
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<td>PEC-EE-410</td>
<td>Advances in Power Transmission &amp; Distribution</td>
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### TABLE-IV
**OPEN ELECTIVE LIST FOR VII SEM (Open Elective-III)**

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<tr>
<td>1</td>
<td>OEC-EE-401</td>
<td>Intelligent Systems &amp; Control</td>
</tr>
<tr>
<td>2</td>
<td>OEC-EE-403</td>
<td>Renewable Energy and distributed generation</td>
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<tr>
<td>3</td>
<td>OEC-EE-405</td>
<td>Reliability engineering</td>
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<tr>
<td>4</td>
<td>OEC-CE-448</td>
<td>Traffic Engineering and Road Safety</td>
</tr>
<tr>
<td>5</td>
<td>OEC-ME-410</td>
<td>Quality Engineering</td>
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### TABLE-V
**OPEN ELECTIVE LIST FOR VII SEM (Open Elective-IV)**

<table>
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<tbody>
<tr>
<td>1</td>
<td>OEC-EE-407</td>
<td>Solar Photovoltaic Technology</td>
</tr>
<tr>
<td>2</td>
<td>OEC-EE-409</td>
<td>Energy Conservation and Management</td>
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<td>3</td>
<td>OEC-CE-450</td>
<td>Disaster Management</td>
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<td>4</td>
<td>OEC-ECE-451</td>
<td>Electronic Principles</td>
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<td>5</td>
<td>OEC-MATH-405</td>
<td>Advance Engineering Mathematics</td>
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<td>6</td>
<td>OEC-CSE-430</td>
<td>Computer Communication</td>
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</table>
2 Hours per week per batch for one teacher and batch size will be decided by the HOD/Chairperson of the department.

Procedure for Examination and continuous Assessment

(A) External Exam Marks
1. Project Evaluation 100 Marks
2. Project Seminar 100 Marks
3. Project Viva 100 marks

(B) Continuous Assessment Marks
1. Assessment by Internal Examiner and Viva 150 Marks
   (Before the Committee Constituted by Chairman of the Department)
2. Assessment by Industrial Guide 50 Marks
Course code | PEC-EE-401
---|---
Category | Program Elective Course
Course title | Power Management

<table>
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</table>

Class work | 25 Marks
Exam | 75 Marks
Total | 100 Marks
Duration of Exam | 3 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes:
At the end of this course, students will be able to:
- Know about the present power scenario of India.
- Know about the general layout of various engineering equipments.
- Know theoretically and practically about power utilities of Haryana.
- Know about various risks and hazards in the concerned area.

SECTION A
INTRODUCTION: Power Scenario, Power Development, Planning, Power resources, Environment Power matters Plan, Pre-feasibility and feasibility studies, State relations for Power etc.
RESOURCES: Resources, Geophysical study, Seismic Considerations, Environmental Restraints, Resettlement and Rehabilitation.

SECTION B
PROCUREMENT: Contracting and Procurement, Consulting Services, Types of Contracts, Project Management, Organization and Economy Management, Organizational Planning and Time Scheduling, Project Cost Control.
ENGINEERING: Engineering & General Layout of Equipments, Generator, Transformer and Switch Gear and Control Equipment, Construction Methods, Operation and Maintenance Principle, Maintenance organization and planning, Availability, life cycle cost & future development. Visits to sites.

SECTION C
POWER SECTOR: Power sector structure in different states, Regulatory Regime in those states, Power utilities in Haryana, Grid management, Power financing, Visit to sites.
PPOWER STATION: Management of Fuel, water Resource Electricity deviend scenario storage and handling, Pricing, Contract etc., Human resource management. Visit to sites.

SECTION D
RISK & HAZARD: Introduction to risk, rules and regulation Aspects of Risk & Hazard Health & risk assessment visit to site.

ELECTRICITY INDUSTRY STRUCTURE & SAFETY REGULATIONS BILL & ETC.: State and Central Power boards / Power corporations.

Text / Reference Books:
1. Electricity Bill, Safety & Conservation Act
**Course code** | PEC-EE-403  
---|---  
**Category** | Program Elective Course  
**Course title** | Electrical Engineering Drawing  
**Scheme and Credits** |  
| L | T | P | Credits | Semester 7\(^{th}\)  
|---|---|---|---|---  
| 3 | 0 | 0 | 3 |  
**Class work** | 25 Marks  
**Exam** | 75 Marks  
**Total** | 100 Marks  
**Duration of Exam** | 3 Hours  

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

**Course Outcomes:**

At the end of this course, students will demonstrate the ability to:
1. Understand the basic design and drawing for armature, transformer, d.c. machine, induction motor and synchronous machine and substation individually.
2. Understand the complete detailed design of all static and rotating machines and their performance with problems.
3. Understand to analyze the design procedure and performance of various algorithms.

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**Section-A**

ARMATURE: Simplex lap/wave dc armature windings, Simplex lap/ wave, integral/ fractional slot, double layer three phase ac armature windings, Single layer three phase ac armature windings.

**Section-B**

TRANSFORMER: Sectional plan and elevation of a transformer limb with windings, Sectional plan and elevation of the core assembly of a power transformer, Sectional plan and elevation of a distribution transformer tank with its accessories.

**Section-C**

DC MACHINES: Sectional front and side elevation of armature with commutator, Sectional front and side elevation of yoke and pole assembly with field winding, Sectional front and side elevation of assembled Machine.

ALTERNATORS: Sectional front and side elevation of water wheel rotor assembly with winding, Sectional front and side elevation of salient pole alternator, Sectional front and side elevation of turboalternator.

INDUCTION MOTORS: Sectional front and side elevation of slip ring induction motor, Sectional front and side elevation of squirrel cage induction motor, Experiments using ElectricalCAD.

**Section-D**

SUBSTATIONS: Layouts and single line diagrams of outdoor and indoor substations, Layout of a 220KV substation, Layout of a captive power substation, Single line diagram of a distribution center.

**Text/References:**

<table>
<thead>
<tr>
<th>Course code</th>
<th>PEC-EE-405</th>
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<tr>
<td>Category</td>
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<tr>
<td>Course title</td>
<td><strong>Utilization of Electrical Power</strong></td>
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<tr>
<td>Scheme and Credits</td>
<td>L  T  P  Credits</td>
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<td>Exam</td>
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<td>Total</td>
<td>100 Marks</td>
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<tr>
<td>Duration of Exam</td>
<td>3 Hours</td>
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</table>

**Course Objectives:**
1. This Course provides an introduction to the principles of electrical drives and their applications in daily life.
2. This course deals with the fundamentals of illumination and its classification.
3. Provides knowledge on electrical traction systems

**Course Outcomes:**
At the end of this course, students will demonstrate the ability to
1. To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition
2. To acquaint with the different types of heating and welding techniques
3. To study the basic principles of illumination and its measurement
4. To understand the basic principles of electric traction including speed–time curves of different traction services

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

**Section-A**
**ELECTRIC DRIVES:** Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

**Section-B**
**ELECTRIC HEATING & ELECTRIC WELDING:** Advantages and methods of electric heating, resistance heating, induction heating, and dielectric heating. Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding

**Section-C**
**ILLUMINATION**
Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light. Discharge lamps, MV and SV lamps comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

**Section-D**
**ELECTRIC TRACTION**

**TEXT BOOKS:**

**REFERENCE BOOKS:**
Course code     PEC-EE-407
Category        Program Elective Course
Course title    Advanced Course in Power Electronics
Scheme and Credits

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Class work     25 Marks
Exam           75 Marks
Total          100 Marks
Duration of Exam 3 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:
1. To review basic concepts of power electronics in the field of power control and drives.
2. To address the underlying concepts and methods behind Advanced Power Electronics.
3. To impart knowledge of power semiconductor technologies and their advancement in the field of power conversion.

Course Outcomes:
1. Theoretical and practical knowledge on modern day semiconductor devices, their characteristics and control.
2. Understanding operation and analysis of switched mode DCDC converters and their designing.
4. Working knowledge of static applications of advanced power electronics like UPS, HVDC, Automotive etc.

SECTION A
Advanced solid state devices such as MOSFETs, IGBT, GTO, IGCT etc, their power modules, intelligent power modules, thermal design, protection, gating circuits, digital signal processors used in their control. Non-isolated and isolated dc-dc converters such as buck, boost, buck-boost, flyback, forward, Cuk, SEPIC, Zeta, half bridge, push-pull and bridge in DCM and CCM, single-phase, single-stage converters (SSSSC), power factor correction at mains in these converters, their application in SMPS, UPS, welding and lighting systems.

SECTION B
Improved power quality ac-dc converters such as single-phase buck, boost, buck-boost ac-dc converters, PWM (Pulse width modulated) based single phase, three-phase VSC (Voltage source converters), multilevel VSCs, multipulse VSCs, PWM CSC (Current voltage source converters), multipulse ac-dc converters, power quality mitigation devices such as passive filters, active filters, hybrid filters, DTSTCOM (Distribution static compensator), DVR (Dynamic voltage restorers) and UPQC (Universal power quality conditioners).

SECTION C
FACTS devices such TCR (thyristor controlled reactor), TSC (thyristor switched capacitors), STATCOM (Static synchronous compensator), SSSC (Static series synchronous compensator), UPFC (Unified power flow controller), IPFC (Interline power flow controller), HVDC (High voltage direct current) system such as 12-pulse converter based HVDC systems, HVDC light, HVDC PLUS (Power universal link), multipulse and multilevel VSC based flexible HVDC systems.

SECTION D
Solid state controllers for motor drives such as vector control and direct torque control of induction motor, synchronous motor, permanent magnet sine fed motor, synchronous reluctance motor, permanent magnet brushless dc (PMLDC) motor, LCI (load commutated inverter) fed large rating synchronous motor drives, energy conservation and power quality improvement in these drives.

Text / Reference Books:
13. http://nptel.iitm.ac.in
Course code | PEC-EE-409
---|---
Category | Program Elective Course
Course title | Power Systems Planning & Reliability

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<td>Duration of Exam</td>
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Course Objectives:
1. Understand the power system planning objectives
2. Understand the generating system planning issues.
3. Understand the load forecasting
4. Understand basic concept of reliability

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the concept of power system planning.
2. Evaluate the peak demand and energy requirements of system using forecasting techniques.
3. Understand concepts of Reliability Evaluation of generation, transmission and distribution system.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A
Introduction: Objectives of planning, Long and short term planning, Planning of generation, transmission and distribution systems. Least Cost Power Planning, Integration of DSM.

Section-B

Section-C

Section-D

Text / References
<table>
<thead>
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<th>Course code</th>
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<tr>
<td>Course title</td>
<td>Modeling and Analysis of Electrical Machines</td>
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<td>Scheme and Credits</td>
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<tr>
<td>Duration of Exam</td>
<td>3 Hours</td>
</tr>
</tbody>
</table>

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

**Course Outcomes:**
At the end of this course, students will demonstrate the ability to
- Understand the basic principle and operation analysis of rotating machines.
- Understand the complete operation of rotating machines and their performance evaluation with problems.
- Understand and analyze the various reference frame and algorithms for electrical machines.

**Section-A**
**BASIC PRINCIPLE OF ELECTRICAL MACHINE ANALYSIS OPERATION AND STEADY STATE BEHAVIOUR OF ELECTRICAL MACHINES:** Review on basic magnetic circuits, Electromagnetic energy conversion, Principles of energy flow, Steady state equations of dc machines, rotating field theory, operation of Induction motor, operation of Synchronous motor.

**REFERENCE FRAME THEORY:** stator and rotor voltage equations and torque equation in different reference frame, linearized machine equations and eigen value analysis.

**Section-B**
**DC MACHINE MODELLING:** Mathematical modeling of dc machine (Separately excited, shunt and series type), Elements of generalized theory Basic two pole machine-primitive 2 axis machine, voltage and current relationship, torque equation

**Section-C**
**INDUCTION MACHINE MODELLING:** Poly phase Induction Machines- Mathematical Modeling of Induction Machines. Voltage and torque equations in machine variables, distributed winding in ac machinery, winding function, air gap mmf, rotating mmf, derivation of induction motor model in rotor flux and stator flux oriented referenceframe.

**Section-D**
**SYNCHRONOUS MACHINE MODELLING:** Voltage and torque equation of salient pole synchronous machine including damper winding in stator and rotor reference frame, derivation of steady statemodel.

**Text/References:**
Course code: PEC-EE-413
Category: Program Elective Course
Course title: Microcontroller Based System Design

<table>
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<tr>
<td>Duration of Exam</td>
<td></td>
<td></td>
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<td>3 Hours</td>
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Course Objectives:
1. To introduce the architecture of PIC microcontroller
2. To educate on use of interrupts and timers
3. To educate on the peripheral devices for data communication and transfer
4. To introduce the functional blocks of ARM processor

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. To understand and apply computing platform and software for engineering problems.
2. To understand ethical issues, environmental impact and acquire management skills.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 10 parts of 1.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A

UNIT I INTRODUCTION TO PIC MICROCONTROLLER

Section-B

UNIT II INTERRUPTS AND TIMER

Section-C

UNIT III PERIPHERALS AND INTERFACING

Section-D

UNIT IV INTRODUCTION TO ARM PROCESSOR
ARM Architecture—ARM programmer’s model—ARM Development tools—Memory Hierarchy—ARM Assembly Language Programming—Simple Examples—Architectural Support for Operating systems. 3-Stage Pipeline ARM Organization—5-Stage Pipeline ARM Organization—ARM Instruction Execution—ARM Implementation—ARM Instruction Set.

Text / References
Course code | PEC-EE-415
---|---
Category | Program Elective Course
Course title | Advanced Power Transmission

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Class work | 25 Marks
Exam | 75 Marks
Total | 100 Marks
Duration of Exam | 3 Hours

Course Objectives:
1. Understand knowledge of Extra High Voltage AC & DC Transmission System
2. To understand and estimation of transmission line parameters.
3. To obtain the equivalent circuits of the transmission lines for determining voltage regulation and efficiency.
4. To know about the FACTS controllers.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Discuss Modelling of the transmission line parameters.
2. Explain the equivalent circuits for the transmission lines based on distance and determine voltage regulation and efficiency.
3. To deal with the importance of HVDC Transmission and HVDC Converters
4. Knowledge of Modern power controllers to enhance the stability and capability of existing network.
5. Monitoring and improvement of Power Quality

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A
EHV AC Transmission: Need of EHV transmission, standard transmission voltage, electrical and mechanical considerations of EHV lines, surface voltage gradients in conductor, distribution of voltage gradients on sub-conductors, Features of EHV transmission lines.

Section-B
HVDC Transmission: DC links, components and configurations, converter station, operation and controls of converters, characteristics, power control, starting and stopping of dclink.

Section-C
Flexible AC Transmission Systems: Fundamentals of ac power transmission, transmission problems and needs, Mechanism of active and reactive power flow control, basic FACTS controllers with application and principles of operation.

Section-D
Power Quality: Overview and definition of power quality, Sources of pollution, power quality disturbances, voltage fluctuations, unbalance waveform distortion, power frequency variations, mitigation and control of power quality issues.

Text / References
5. Flexible Ac Transmission Systems, Yong-Hua Song, Allan T. Johns, IEE publication
Course code | PEC-EE-417
---|---
Category | Program Elective Course
Course title | Computer Aided Power System Analysis

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Class work | 25 Marks
Exam | 75 Marks
Total | 100 Marks
Duration of Exam | 3 Hours

**Course Objectives:**
1. To introduce computer applications in the analysis of power systems
2. To understand the solution methods and techniques used in power system studies

**Course Outcomes:**
At the end of this course, students will demonstrate the ability to
1. To understand the solution methods and techniques used in power system studies

**Note:** Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

**Section-A**
Network matrix: Primitive network, bus incidence matrix, formation of Y-bus by singular transformation, networks with mutually coupled elements, formation of Z-bus by matrix inversion, formation of Z-bus using the building algorithm—addition of a tree branch p to reference bus, addition of a link between buses p and q, addition of a link between bus p and reference bus.

**Section-B**

**Section-C**
SYMMETRICAL AND UNSYMMETRICAL FAULT ANALYSIS: Single line to ground fault, Line to Line fault, Double line to Ground fault and symmetrical fault. Consideration of Pre fault currents. Symmetrical Components.

**Section-D.**
COMPUTER CONTROL & AUTOMATION: Introduction to energy control centres, various states of a power system, SCADA Systems and RTU. Introduction to the MATLAB Power System block Set. Introduction of the features of EMTP.

**Text / References**
6. Advance power system analysis and dynamics by L.P. Singh: Wiley Eastern ltd.
Course code: OEC-EE-401

Category: Open Elective Course

Course title: Intelligent Systems and Control

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Course Outcomes:
At the end of this course, students will be able to:
- Know about the basics approaches to intelligent controls.
- Know about basics and working of various types of fuzzy based controllers.
- Familiar to the basics and the practical implementations of the neural networks.
- Know about importance of the optimization techniques.

SECTION A
Introduction: Approaches to intelligent control; Architecture for intelligent control; Symbolic reasoning system; rule-based systems; AI approach; Knowledge representation; Expert systems.

SECTION B
Fuzzy Logic Control System: Motivation and basic definitions; Fuzzy arithmetic and Fuzzy relations; Fuzzy logic modelling and control; Fuzzy knowledge and rule bases; Fuzzy modelling and control schemes for nonlinear systems; Self-organizing fuzzy logic control; Fuzzy logic control for nonlinear time-delay system; Stabilization using fuzzy models; Fuzzy estimators; Adaptive fuzzy control.

SECTION C
ANN Based Controllers and Estimators: Concept of Artificial Neural Networks and its basic mathematical model; McCulloch-Pitts neuron model; simple Perceptron; Adaline and Madaline; Feed-forward Multilayer Perceptron; Learning and Training the neural network; Data Processing: Scaling; Fourier transformation; principal-component analysis and wavelet transformations; Hopfield network; Self-organizing network and Recurrent network; Neural Network based controllers and estimators.

SECTION D
Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps; Adjustment of free parameters; Solution of typical control problems using genetic algorithm; Concept on some other search techniques like tabu search; and colony search techniques for solving optimization problems; Evolutionary Fuzzy Logic controllers.

Text / Reference Books:
Course code: OEC-EE-403
Category: Open Elective Course
Course title: Renewable Energy and Distributed Generation

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Course Objectives:
1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources.
3. To understand Power Electronics Interface with the Grid

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand about renewable energy.
2. Understand the working of distributed generation system in autonomous/grid connected modes.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A
Introduction: Introduction of Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.

Section-B

Section-C
Power Electronic Interface with the Grid, Impact of Distributed Generation on the Power System, Power Quality Disturbances

Section-D
Transmission System Operation, Protection of Distributed Generators, Economics of Distributed Generation

Text/References
Course code: OEC-EE-405

Category: Open Elective Course

Course title: Intelligent Systems and Control

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Class work: 25 Marks

Exam: 75 Marks

Total: 100 Marks

Duration of Exam: 3 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Outcomes:

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

- Know about the basics approaches to intelligent controls.
- Know about basics and working of various types of fuzzy based controllers.
- Familiar to the basics and the practical implementations of the neural networks.
- Know about importance of the optimization techniques.

SECTION-A

Introduction: Approaches to intelligent control; Architecture for intelligent control; Symbolic reasoning system; rule-based systems; AI approach; Knowledge representation; Expert systems.

SECTION-B

Fuzzy Logic Control System: Motivation and basic definitions; Fuzzy arithmetic and Fuzzy relations; Fuzzy logic modelling and control; Fuzzy knowledge and rule bases; Fuzzy modelling and control schemes for nonlinear systems; Self-organizing fuzzy logic control; Fuzzy logic control for nonlinear time-delay system; Stabilization using fuzzy models; Fuzzy estimators; Adaptive fuzzy control.

SECTION-C

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SECTION-D

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps; Adjustment of free parameters; Solution of typical control problems using genetic algorithm; Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems; Evolutionary Fuzzy logic controllers.

Text / Reference Books:

COURSE OBJECTIVES:

1. Acquaint the students to basic concepts of Traffic and their significance.
2. To stimulate the students to think systematically and objectively about various traffic problems

COURSE OUTCOMES:
After completing this course, students should be able:

1. To realize the significance of traffic engineering in today life.
2. To understand the processes involved in traffic studies.
3. To appreciate the role of Traffic regulations.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Module-1: Traffic Characteristics: Importance of traffic characteristics. Road user characteristics. Vehicular characteristics. Max dimensions and weights of vehicles allowed in India.
Module-2: Traffic Studies: Traffic volume study, speed study and origin and destination study. Speed and delay study.

Unit-II

Module-4: Relationship between speed, volume and density, PCU, Design service volume, Capacity of non-urban roads. IRC recommendations, Brief review of capacity of urban roads.

Unit-III


Unit-IV

Module-6:Road safety audit, RSA team, RSA Report, Elements of RSA, Vehicular air pollution and Situation in India, Motor vehicle act, Vehicular emission norms in India and abroad, Alternate fuels, Factors affecting fuel consumption.

RECOMMENDED BOOKS:
Course code | OEC-ME-410  
Category | Open Elective Courses (OEC)  
Course title | QUALITY ENGINEERING  

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Objectives: To understand the concept of Quality Engineering which emphasizes growth, creativity, and analytical thinking.

Class work | 25 Marks  
Exam | 75 Marks  
Total | 100 Marks  
Duration of Exam | 03 Hours  

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section A  
**Basic Concepts of Quality:** Definitions of Quality and its importance in industry, Quality function, Quality Characteristics, Quality process, Quality Traits, Applications of Quality Concept, Introduction to quality control, Computer aided quality control, Total quality control (TQC) and its implementation, Elements of TQC, Quality Circle, Objectives of quality circle, Role of management in quality circle, Quality in service organizations, characteristics of a service organization, Important service dimensions, Design of service quality.

Section B  
**Basic Statistical Concepts:** The Concept of variation, Distinction between variables and attributes data, The frequency distribution, graphical representation of frequency distribution, Quantitative description of distribution, the normal curve, concept of probability, laws of probability, probability distributions, hyper geometric distribution, binomial distribution, The Poisson distribution.

Section C  
**Quality systems:** Quality systems, Need for quality System, Need for standardization, History of ISO:9000 series standards and its features, steps to registration, India and ISO:9000, Automated inspection systems technologies, Different forms of Inspection, Industrial inspection.

Section D  
**Total Quality Management:** Introduction of TQM, Concepts, Characteristics of TQM, Relevance of TQM, Approaches to TQM Implementation, TQM philosophies, Taguchi Philosophy, JIT, Kaizen, Six Sigma approach, 5-Sapproach.

Course Outcomes:  
Upon completion of this course the student will be able to:  
CO1 - Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability  
CO2 - Use control charts to analyze for improving the process quality.  
CO3 - Describe different sampling plans  
CO4 - Acquire basic knowledge of total quality management  
CO5 - Understand the modern quality management techniques.
Text Books:
1. Quality planning and Analysis, Juran and Gryna, TMH, NewDelhi
2. Quality Management, Kanishka Bed, Oxford University Press, NewDelhi
3. Introduction to SQC, Montgomery DC, 3e, Wiley, NewDelhi

Reference Books:
Course code: OEC-EE-407
Category: Open Elective Courses (OEC)
Course title: SOLAR PHOTOVOLTAIC TECHNOLOGY

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Class work: 25 Marks  
Exam: 75 Marks  
Total: 100 Marks  
Duration of Exam: 03 Hours

Course Objectives:
On end of the syllabus or completion of the course, students will be able
1. Understand the electrical properties and Behaviour of Solar Cells.
2. To design of various PV-interconnected systems.
3. To understand about the comparison of various source applications.

Course Outcomes:
Upon successful completion of the course, students will be able
1. To explain basics of solar photovoltaic systems.
2. To know in depth of its types and design of various PV-interconnected systems.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section - A
PHOTOVOLTAIC BASICS: Structure and working of Solar Cells - Types, Electrical properties and Behaviour of Solar Cells - Cell properties and design - PV Cell Interconnection and Module Fabrication - PV Modules and arrays - Basics of Load Estimation.

Section - B
STAND ALONE PV SYSTEMS: Schematics, Components, Batteries, Charge Conditioners - Balance of system components for DC and/or AC Applications - Typical applications for lighting, water pumping etc.

Section - C

Section - D
HYBRID SYSTEMS: Solar, Biomass, Wind, Diesel Hybrid systems - Comparison and selection criteria for a given application.

REFERENCES
Course code: OEC-EE-409
Category: Open Elective Courses (OEC)
Course title: Energy Conservation and Management

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Class work: 25 Marks
Exam: 75 Marks
Total: 100 Marks
Duration of Exam: 03 Hours

Course Objectives:
1. Understand and analyse the energy data of industries
2. Carryout energy accounting and balancing
3. Conduct energy audit and suggest methodologies for energy savings and utilise the available resources in optimal ways
4. To present a problem oriented in depth knowledge of Energy conservation management
5. To address the underlying concepts and methods behind Energy conservation management

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the basic knowledge of different terms & principles of energy conservation, audit and management.
2. Evaluate the energy saving & conservation in different mechanical utilities.
3. Understand efficient heat & electricity utilization, saving and recovery in different thermal and electrical system.
4. Prepare energy audit report for different energy conservation instances.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A

Section-B

Section-C

Section-D

Text / References
Course code | OEC-CE-450
---|---
Category | Open Elective Course
Course title | Disaster Management

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Class work | 25 Marks
Exam | 75 Marks
Total | 100 Marks
Duration of Exam | 3 Hours

COURSE OBJECTIVES:
1. To provide basic conceptual understanding of disasters and its relationships with development.
2. Provide an understanding of the social nature of natural hazards and disasters.
3. Increase awareness of hazards and disasters around the world and the unequal social consequences stemming from disaster events.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit I

Introduction: Terminology, Global and Indian scenario, role of engineer, importance of study in human life, long term effects of disaster. Geological Mass Movement and land disasters, Atmospheric disasters, Disaster Mitigation

Unit II

Natural Disaster: Nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozonedepletion

Man-made Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.

Unit III

Case Studies: Damage profile analysis- Uttarkashi/Bhuj/Latur earthquakes, Kerala floods, cyclone Fani and Amphan, Bihar floods, Covid 19.

Unit IV

Disaster Management: Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Applications of GIS, Remote sensing and GPS in this regard.

COURSE OUTCOMES:
After completing this course, students should be able:
1. To know natural as well as manmade disaster and their extent and possible effects on the economy.
2. To plan national importance structures based upon the previous history.
3. To acquaint with government policies, acts and various organizational structures associated with an emergency.
4. To know the simple dos and don’ts in such extreme events and act accordingly.

**REFERENCE BOOKS:**

Course code: OEC-ECE-451

Category: Open Elective Course

Course title: Electronic Principles

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Exam: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objective:
1. Study the basic principles of electronic systems.
2. Understand working of Digital electronics.
3. Understand the working of Display devices.

UNIT 1 SEMICONDUCTOR DIODE: P-N junction and its V-I Characteristics, P-N junction as a rectifier, Switching characteristics of Diode. Diode as a circuit element, the load-line concept, half-wave and full wave rectifiers, clipping circuits, clamping circuits, filter circuits, peak to peak detector and voltage multiplier circuits.

UNIT 2 ELECTRONIC DEVICES: LED, Zener Diode as voltage regulator, BJT, UJT, MOSFET, Thyristor, DIAC, TRIAC.

UNIT 3 DISPLAY DEVICES: LED, LCD, Seven Segment, Sixteen Segment.

UNIT 4 DIGITAL ELECTRONICS: Binary, Octal and Hexadecimal number system and conversions, Boolean Algebra, Truth tables of logic gates (AND, OR, NOT) NAND, NOR as universal gates, Difference between combinational circuits and sequential circuits, Introduction to flipflops (S-R & J-K).

TEXT BOOK: 1. Integrated Electronics: Millman & Halkias; McGrawHill

REFERENCE BOOKS:
1. Electronics Principles: Malvino; McGrawHill
2. Electronics Circuits: Donald L. Schilling & Charles Belove; McGrawHill

Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. Understand the working of electronic components.
2. Understand the Digital System and various displays.
Course code: OEC-MATH-405

Category: Open Elective Course

Course title: Advanced Engineering Mathematics

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Class work 25 Marks
Exam 75 Marks
Total 100 Marks
Duration of Exam 3 Hours

Course Objectives:
1. To understand the basic knowledge of linear and Nonlinear programming problems.
2. To understand the various useful probability distribution and theory of statistics in sample testing.
3. To understand the various method to solve the Linear programming Problems (LPP) and Nonlinear LPP.

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

1. Estimate the actual complexity of the Linear programming Problems (LPP) and Nonlinear LPP.
2. Explain the main principles for constructing the optimal methods for solving different types of minimization problems.
3. Experience in solving difficult Linear programming Problems (LPP) and Nonlinear LPP.
4. Experience to apply the various useful statistical test of the hypothesis testing of real-world problems.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Section-A
Optimization Fundamentals: Definition; classification of optimization problems; Unconstrained and constrained optimization; optimality conditions. Lagrange Multipliers, formulation of multivariable optimization, Kuhn-Tucker conditions.
Linear Programming: Simplex Method; Duality; Sensitivity Analysis; Dual Simplex method. Assignment Problem.

Section-B
Nonlinear Programming: Powel’s method; steepest descent method; conjugates gradient method; Newton’s Method GRG method; Sequential quadratic programming; Penalty function method; Augmented Lagrange multiplier method.

Section-C
Dynamic Programming and Integer Programming: Interior point methods; Karmakar’s algorithm; Dual affine; Primal affine; Barrie algorithm.

Section-D
Statistics and Probability: Probability theory, Baye’s theorem, Binomial, Poisson and normal distributions, testing of hypothesis, Chi square test- goodness of fit, Student’s t-test, F-test.

Text / References
Learning Objectives:

1. To Build an understanding of the fundamental concepts of computer networking and familiarizing the student with the basic taxonomy and terminology of the computer networking and data communication.
2. To outline various models, topologies and devices of Computer Networks.
3. To explain the functions of various layers in Network Reference Model.
4. To apply different network concepts in various network communication protocols.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each Unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Unit 1


Unit 2


Unit 3


Unit 4

LAN interconnecting devices: Repeater, Hubs, Switches, Bridges, Routers, Gateways. Internet and E-mail: Concept of Internet, Advantages of Internet, Security issues in using internet. Application of Internet in various fields: Scientific, Business, Research, Sports, Medicine & Health Care, Engineering, Teaching. HTTP and FTP. Email: concept, Protocols: SMTP, POP, IMAP.
Text Book:
4. Reference Books:

Learning Outcomes:
By the end of the course the students will be able to:
1. Independently understand basic computer network technology.
2. Understand and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
5. Identify the different types of network devices and their functions within a network.
Course code | HSMC-08
---|---
Category | Open Elective Course
Course title | FUNDAMENTALS OF MANAGEMENT

| Scheme and Credits | L | T | P | Credits |
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Objectives:

Students will be able to understand:
2. The importance of staffing and training
3. The concept of material management and inventory control
4. The components of marketing and advertising
5. Various sources of finance and capital structure.

Class work 25 Marks
Exam 75 Marks
Total 100 Marks
Duration of Exam 03 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

UNIT-I

UNIT-II
Production Management: Definition, Objectives, Functions and Scope, Production Planning and Control; its significance, stages in production planning and control. Brief introduction to the concepts of material management, inventory control; its importance and various methods.

UNIT-III
Marketing Management - Definition of marketing, marketing concept, objectives & Functions of marketing. Marketing Research - Meaning; Definition; objectives; Importance; Limitations; Process. Advertising - meaning of advertising, objectives, functions, criticism.

UNIT-IV

Course outcomes:
Students will be able to understand
CO1 - Evolution of Management and contribution of Management thinkers.
CO2 - importance of staffing and training
CO3 - the concept of material management and inventory control
CO4 - the components of marketing and advertising
CO5 - various sources of finance and capital structure

TEXT BOOKS:

REFERENCES:
1. Principles & Practices of Management – L.M. Prasad (Sultan Chand &Sons)
Course code: PEC-EE-402
Category: Program Elective Course
Course title: Special Electrical Machines

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Semester 7th

Class work: 25 Marks
Exam: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Course Outcomes:
At the end of this course, students will demonstrate the ability to:
1. Impart knowledge on construction, principle of operation and performance of all ac and dc machines with small and higher rating.
2. Understand the concepts of rotating magnetic fields.
3. Analyze performance characteristics of ac machines.
4. Prepare the students to have a basic knowledge about motoring, generating and braking mode of ac machines.

UNIT-I
POLY-PHASE AC MACHINES: Construction and performance of double cage and deep bar three phase induction motors, production of rotating magnetic field, induction motor action, e.m.f. induced in rotor circuit of slip ring induction motor, concept of constant torque and constant power controls, static slip power recovery control schemes (constant torque and constant power), stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control, induction motor as an induction generator.

UNIT-II
SINGLE-PHASE INDUCTION MOTORS: Construction, equivalent circuit, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor start capacitor-run and shaded pole motors.
SINGLE-PHASE COMMUTATOR MOTORS: Construction, principle of operation, characteristics of universal and repulsion motors; Linear Induction Motors. Construction, principle of operation, applications.

TWO PHASE AC SERVO MOTORS: Construction, torque-speed characteristics, performance and applications.

UNIT-III
STEPPER MOTORS: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications.

SWITCHED RELUCTANCE MOTORS: Construction; principle of operation; torque production, modes of operation, drive circuits.

UNIT-IV
PERMANENT MAGNET MACHINES: Permanent magnet dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors;

TEXT/REFERENCE BOOKS:
1. Principle of Electrical Machines, V K Mehta, Rohit Mehta, Schand
2. Electric Machines, Ashfaq Hussain, DhanpatRai
4. Generalized theory of Electrical Machines: P.S. Bhimbra (Khanna Pub.)
5. Electric Machinery, Fitzgerald and Kingsley, MGH.
Course code: PEC-EE-404

Category: Program Elective Course

Course title: Applications of Power Electronics in Power Systems

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Class work: 25 Marks
Exam: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The student has to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:
1. Theoretical and practical knowledge on modern day semiconductor devices, their characteristics and control.
2. Knowledge of power conditioners and their application.
3. Working knowledge of static applications of advanced power electronics like UPS, HVDC, etc.
4. Learning Modeling and Analysis of FACTS controllers.

Course Outcomes:
1. Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices.
2. Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits.
3. Design and analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.
4. Formulate and analyze a power electronic design at the system level and assess the performance. Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.
5. Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.

SECTION-A
Steady state and dynamic problems in AC systems: Flexible AC transmission systems (FACTS), Principles of series and shunt compensation, Description of static var compensators (SVC), Thyristor Controlled series compensators (TCSC), Static phase shifters (SPS), Static condenser (STATCON), Static synchronous series compensator (SSSC) and Unified power flow controller (UPFC).

SECTION-B
Modeling and Analysis of FACTS controllers: Control strategies to improve system stability, Power Quality problems in distribution systems

SECTION-C
Harmonics: Harmonics creating loads, modeling, harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters.

SECTION-D
Voltage sags & swells, voltage flicker, Mitigation of power quality problems using power electronic conditioners, IEEE standards, HVDC Converters and their characteristics, Control of the converters (CC and CEA), Parallel and series operation of converters.

Text / Reference Books:
Course code: PEC-EE-406
Category: Program Elective Course
Course title: Power System Stability

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Semester 7th
Class work: 25 Marks
Exam: 75 Marks
Total: 100 Marks
Duration of Exam: 3 Hours

Course Objectives:
1. Understand the general information about power system stability problems.
2. Understand the classification and prevention of different types of stability.
4. Understand the state space model and state space representation of simplified model of synchronous machines.
5. Understand the causes and prevention of dynamic stability.
6. Understand the causes and prevention of transient stability.
7. Understand the causes and prevention of voltage stability.
8. Understand the general information about voltage collapse and how to overcome voltage collapse.

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Understand the classification of stability.
2. Know power system stability problem.
4. How to handle various stability and unstability problems.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Section-A
Power System Stability: Rotor angle stability, voltage stability, short term and long term stabilities, swing equation and its solution techniques

Section-B
Synchronous Machine and Its Modelling: Power transformation, flux linkage equations, voltage equation, formulation using state-space equations, normalizing voltage and torque eqns., equivalent circuit of synchronous m/c, the flux linkage state-space model. Linearization of the flux linkage model, Simplified linear model block diagram, state-space representation of simplified model

Section-C
Dynamic Stability: State-space representation, stability of a dynamic system, analysis of stability, Eigen properties of the state matrix, Small signal stability of a single m/c infinite bus system, Effect of excitation systems, power system stabilizer, system state matrix with armature winding
Transients: Stability of a dynamic system, numerical integration methods, simulation of power system dynamic response

Section-D
VOLTAGE Stability: Basic concept related to voltage stability, voltage collapse, voltage stability analysis, prevention of voltage collapse.

Sub-Synchronous Oscillators: Turbine generator torsional characteristics, characteristics of series capacitor compensated transmission system, Self excitation, torsional interaction, counter measure to SSR problems, ferro resonance.

Text/References
1. Power System Stability and Control by Prabha Kumar: MGH
2. Power System Control and Stability by Anderson and Fouad: Galgotia Publications
3. Extra high voltage AC Transmission Engg. By Rokosh Das Begamudre
4. Electrical energy theory: An Introduction by O.I. Elgerd: TMH
**Course code**: PEC-EE-408  
**Category**: Program Elective Course  
**Course title**: Advanced Control Systems

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Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

**Course Objectives:**

1. To provide a strong concept on the compensator design and on advanced control system analysis and design techniques.
2. To analyze the behavior of discrete time systems and nonlinear control systems.

**Course Outcomes:**

1. Design compensators using classical techniques.
2. Analyze both linear and nonlinear system using state space methods.
3. Analyze the stability of discrete system and nonlinear system.

**SECTION-A**

Types of controller- Feedforward-feedback-cascade-P, PI and PID. Compensator design: Realization of compensators – lag, lead and lag-lead. Design of compensator using bode plot.

Compensator design: Realization of compensators – lag, lead and lag-lead.

**SECTION-B**

State space analysis of systems: Introduction to state concept - state equation of linear continuous time systems, matrix representation of state equations. Phase variable and canonical forms of state representation-controllable, observable, diagonal and Jordan canonical forms- solution of time invariant autonomous systems.

**SECTION-C**


**SECTION-D**

Nonlinear systems: Introduction - characteristics of nonlinear systems. Types of nonlinearities. Analysis through harmonic linearisation - Determination of describing function of nonlinearities (relay, dead zone and saturation only)-application of describing function for stability analysis of autonomous system with single nonlinearity.

**Text / Reference Books:**

5. Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi,2010
Course code: PEC- EE-410
Category: Program Elective Course
Course title: Advances in Power Transmission & Distribution

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Course Objectives:
1. Understand Knowledge of Extra High Voltage AC & DC Transmission System
2. To understand and estimation of transmission line parameters.
3. To obtain the equivalent circuits of the transmission lines for determining voltage regulation and efficiency.
4. To know about the FACTS controllers.

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

1. Discuss Modelling of the transmission line parameters.
2. Explain the equivalent circuits for the transmission lines based on distance and determine voltage regulation and efficiency.
3. To deal with the importance of HVDC Transmission and HVDC Converters
4. Knowledge of Modern power controllers to enhance the stability and capability of existing network. 5 Monitoring and improvement of Power Quality

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Text / References
1. Flexible Ac Transmission Systems, Yong-Hua Song, Allan T. Johns, IEE publication
3. [https://nptel.ac.in/courses/108/107/108107112/](https://nptel.ac.in/courses/108/107/108107112/)


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**OBJECTIVE:**

To teach the student how to face interview and presentation given and remove their hesitation and improve their communications skills and overall personal developments.