UNIVERSITY INSTITUTE OF ENGINEERING AND TECHNOLOGY
MAHARSHI DAYANAND UNIVERSITY, ROHTAK

NEW SCHEME OF STUDIES AND EXAMINATION(w.e.f. 2021-22)

B-TECH 4th YEAR (ELECTRICAL ENGINEERING) SEMESTER-VII

Sl. No.	Course Code	Course Title	Teaching Schedule			Examination Schedule (Marks)				Credit	Duration of Exam (Hours)
			L	T	P	Internal Assessment	Theory	Practical	Total		
1.	Refer to Table-1	Program Elective -IV	3	1	0	25	75	0	100	4	3
2.	Refer to Table-1I	Program Elective -V	3	1	0	25	75	0	100	4	3
3.	Refer to Table-III	Open Elective-III	3	0	0	25	75	0	100	3	3
4.	Refer to Table-IV	Open Elective-IV	3	0	0	25	75	0	100	3	3
5.	PROJ-EE-423G	Project Stage-I	0	0	4	50	0	50	100	2	3
6.	HSMC-08G	Fundamentals of Management	2	0	0	25	75	0	100	2	2
7.	INT –EE-425G	Evaluation of Summer Internship	0	0	2	-	-	-	-	-	-
	Total					175	375	50	600	18	

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

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

S. No.	Course Code	Title of the Course
1.	PEC-EE-401G	Power management
2.	PEC-EE-403G	Electrical Engineering Drawing
3.	PEC-EE-405G	Utilization of Electrical Power
4.	PEC-EE-407G	Advanced Power Electronics
5.	PEC-EE-409G	Power System Planning and Reliability

TABLE-1I
PROGRAM ELECTIVE LIST (Program Elective -V)

S. No.	Course Code	Title of the Course
1.	PEC-EE-411G	Modelling and Analysis of Electrical Machines
2.	PEC-EE-413G	Microcontroller Based System Design
3.	PEC-EE-415G	Advanced Power Transmission
4.	PEC-EE-417G	Computer Aided Power System Analysis

TABLE-III
OPEN ELECTIVE LIST FOR VII SEM (Open Elective-III)

S. No.	Course Code	Title of the Course
1	OEC-EE-401G	Intelligent Systems & Control
2	OEC-EE-403G	Renewable Energy and distributed generation
3	OEC-EE-405G	Reliability engineering
4	OEC-CE- 448G	Traffic Engineering and Road Safety
5	OEC-ME-410G	Quality Engineering

TABLE-IV
OPEN ELECTIVE LIST FOR VII SEM (Open Elective-IV)

S. No.	Course Code	Title of the Course
1	OEC-EE-407G	Solar Photovoltaic Technology
2	OEC-EE-409G	Energy Conservation and Management
3	OEC-CE- 450G	Disaster Management
4	OEC-ECE-451-G	Electronic Principles
5	OEC-MATH-405 G	Advance Engineering Mathematics
6	OEC-CSE-430G	Computer Communication

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

Sl. No.	Course Code	Course Title	Teaching Schedule			Examination Schedule (Marks)				Credit	Duration of Exam (Hours)
			L	T	P	Internal Assessment	Theory	Practical	Total		
1.	Refer to Table-V	Program Elective –VI	3	1	0	25	75	0	100	4	3
2.	Refer to Table-VI	Open Elective-V	3	0	0	25	75	0	100	3	3
3.	Refer to Table-VII	Open Elective-VI	3	0	0	25	75	0	100	3	3
4.	PROJ-EE-422G	Project Stage-II	0	0	8	50	0	100	150	4	3
5.	SEM-EE-424G	Seminar	0	0	2	50	0	50	100	1	3
6.	GP –EE-426G	General Proficiency	0	0	2			50	50	-	3
		Total				175	225	200	600	15	

1. Choose any one subject from TABLE-V
2. Choose any one subject from TABLE-VI
3. Choose any one subject from TABLE-VII

TABLE-V
PROGRAM ELECTIVE LIST FOR VIII SEM (Program Elective –VI)

S. No	Course Code	Title of the Course
1.	PEC-EE-402G	Special Electrical Machines
2.	PEC-EE-404G	Applications of Power Electronics in Power Systems
3.	PEC-EE-406G	Power System Stability
4.	PEC-EE-408G	Advanced Control Systems
5.	PEC-EE-410G	Advances in Power Transmission & Distribution

TABLE-VI
OPEN ELECTIVE LIST FOR VIII SEM (Open Elective-V)

S. No.	Course Code	Title of the Course
1	OEC-EE-402G	Solar Thermal Applications
2	OEC-EE-404G	Electrical Safety and Standards
3	OEC-EE-406G	Industrial control
4	OEC-CE-452-G	Elements of Civil Engineering
5	OEC –ME-402G	Operations Research
6		

TABLE-VII

OPEN ELECTIVE LIST FOR VIII SEM (Open Elective-VI)

S. No.	Course Code	Title of the Course
1	OEC-EE-408G	Solar Energy Appliances
2	OEC-EE-410G	Renewable Energy Converters
3	OEC-EE-412G	Robotics
4	OEC-EE-414G	Energy Management and Auditing
5	OEC-ECE-452-G	Intelligent Instrumentation for Engineers

Power Management

Theory :   75
Class Work :   25
Total :   100
Duration of Exam: 3 Hrs.

Course Code	PEC-EE-401G		
Category	Pogram elective course		
Course title	Power Management		
Scheme	L	T	P
	3	1	-

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 concern 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.

POWER 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
2. Arora & Dom Kundwar, A Course in Power Plant Engineering, Pub.: Dhanpat Rai Pub, 2000.
3. Jain &BalaSubranmanyam, "Power Plant Engineering", Dhanpat Rai Pub.,
4. Butter Worth, A.B. Gill, "Power Plant Performance Management", Pub: 1984.
5. P.C. Sharma, "Power Plant Engineering", Dhanpat Rai Pub.,
6. David A. Decenzo, Stephen P. Robbins, Human Resource Management. New Delhi: PHI Pvt. Ltd., 2004.
7. P.K. Nag, Power Plant Engg. N.Delhi: TMH, 2003

Electrical Engineering Drawing

Theory :			75
Class Work :			25
Total :			100
Duration of Exam :			3 Hrs.

Course Code	PEC-EE-403G		
Category	Program Elective Course		
Course title	Electrical Engineering Drawing		
Scheme	L	T	P
	03	1	-

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 turbo alternator.

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

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:

1: Bhattacharya S.K, Electrical Engineering Drawing, Wiley Eastern, Edition 2.

2: Clayton & Hancock, Performance and Design of DC Machines, ELBS, 1992.

3: Narang K.L., A Text Book of Electrical Engineering Drawing, Tech India Publications.

4: A.K. Sawhney, Electrical Machine Design, Dhanpath Rai, New Delhi, 1991.

5: Say M.G, Performance and Design of AC machines, Pitman, ELBS, 1991.

Utilization of Electrical Power

Theory :   75
Class Work :   25
Total :   100
Duration of Exam :   3 Hrs.

Course Code	PEC- EE-405G		
Category	Program Elective Course		
Course title	Utilization of Electrical Power (Theory)		
Scheme	L	T	P
	3	1	-

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 principle 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
System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking – plugging, rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

Text / References:
TEXT BOOKS:

1. Utilization of Electrical Energy - by E. Opens haw Taylor, University Press.
2. Art & Science of Utilization of Electrical Energy - by Par tab, Dhanpat Ravi & Sons.
REFERENCE BOOKS:
3. Utilization of Electrical Power including Electric drives and Electric traction – by N.V. Suryanarayana, New Age International (P) Limited, Publishers, 1996.
4. Generation, Distribution and Utilization of Electrical Energy - by C.L. Wadhwa New Age International (P) Limited, Publishers, 1997.

Advanced Course in Power Electronics

Theory :	75
Class Work :	25
Total :	100
Duration of Exam:	3 Hrs.

Course Code	PEC-EE-407G		
Category	Program elective course		
Course title	Advanced Course in Power Electronics		
Scheme	L	T	P
	3	1	-

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.

3. Knowledge of power conditioners and their application.

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 ac 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 (thyristorcontrolled 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.

<center>SECTION-D</center>

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:

1. R. S. Ramshaw, "Power Electronics Semiconductor Switches", Champman & Hall, 1993.
2. N. Mohan, T. M. Undeland and W. P. Robbins, "Power Electronics, Converter, Application and Design", Third Edition, John Willey & Sons, 2004.
3. M. H. Rashid, "Power Electronics, circuits, Devices and Applications", Pearson, 2002, India.
4. K. Billings, "Switch Mode Power Supply Handbook", McGraw-Hill, 1999, Boston.
5. A. I. Pressman, "Switch Mode Power Supply Design", McGraw-Hill, 1999, New York.
6. N. G. Hingorani and L. Gyugyi, "Understanding FACTS", IEEE Press, Delhi, 2001.
7. B. K. Bose, "Power Electronics and Variable Frequency Drive", Standard Publishers Distributors, 2000.
8. Bin Wu, "High-Power Converters and AC Drives", IEEE Press, A John Wiley & Sons, Inc Publication, New York, 2006.
9. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, second edition, 1994, Avarua, Rarotonga, Cook Islands.
10. R. C. Duagan, M. F. Mcgranaghan and H. W. Beaty, "Electric Power System Quality", McGraw-Hill, 2001, 1221 Avenue of the Americas, New York.
11. Vijay K. Sood, "HVDC and FACTS Controllers -Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Masachusetts, 2004.
12. J. Arrillaga, Y. H. Liu and N. R. Waston, "Flexible Power Transmission-The HVDC Options", John Wiley & Sons, Ltd, Chichester, UK, 2007. A joint venture by IISc and IITs, funded by MHRD, Govt of India
http://nptel.iitm.ac.in

<center>Power Systems Planning & Reliability</center>

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC- EE-409G		
Category	Program Elective Course		
Course title	Power Systems Planning & Reliability (Theory)		
Scheme	L	T	P
	3	1	-

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 willhave 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

Load Forecasting: Classification and characteristics of loads. Approaches to load forecasting. Forecasting methodology. Short-run and Long run forecasting. Energy forecasting. peak demand forecasting, total forecasting, annual and monthly peak demand forecasting. Electricity Price Forecasting.

Section-C

Basic Reliability Concepts: General reliability function, exponential distributions, meantime to failure, Markov Chains and processes and their applications, simple series and parallel system models.

Static Generating Capacity Reliability Evaluation: Outage definitions, loss of load probability methods, loss of energy probability method. Frequency and duration methods, load forecasting uncertainty.

Section-D.

Transmission System Reliability Evaluation: Average interruption rate method. LOLP method. The frequency and durationmethod.

Distribution System Reliability Analysis: distribution network reliability, reliability performance.

Text / References

1. Roy Billington, 'Power System Reliability Evaluation', Gordan& Breach Scain Publishers,1990.
2. Endrenyi,J., 'Reliability modelling in Electric Power System' John Wiley,1980.
3. Billinton Roy, Allan Ronald, 'Reliability of Power System' Plenum Press,1996.
4. David Elmakias, 'New Computational Methods in Power System Reliability' Springer-Verlag,2008.
5. Ali Chowdhury, Don Koval, 'Power Distribution System Reliability: Practical Methods and Applications, Wiley-IEEE Press,2009.
6. Dasari, S., Electric Power System Planning, IBT Publishers (1999).
7. Pabla, A.S., Electric Power Distribution, Tata McGraw•Hill (2008).–
8. Sullivan, R., Power System Planning, McGraw(1977)
9. Knight, U.G., Power System Engineering and Mathematics, Pergamon Press (1972).
10. McDonald,J.R., Modern Power System Planning, McGraw (2007)

Modeling and Analysis of Electrical Machines

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EE-411G		
Category	Program Elective Course		
Course title	Modeling and Analysis of Electrical Machines		
Scheme	L	T	P
	03	1	-

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 reference frame.

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 state model.

Text/References:

1. P. C. Krause, OregWasynczuk, Scott D. Sudhoff, "Analysis of Electric Machinery and drive systems", IEEE Press, 2002.
2. P. S. Bhimbra, "Generalized Theory of Electrical Machines", Khanna Publications.
3. C.V. Jones " Unified theory of Electrical Machines" Butterworth Publishers, Dec 1967.

Microcontroller Based System Design

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC- EE-413G		
Category	Program Elective Course		
Course title	Microcontroller Based System Design (Theory)		
Scheme	L	T	P
	3	1	-

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
Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx-- Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – SimpleOperations.

Section-B

UNIT II INTERRUPTS AND TIMER
PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine - Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variable strings.

Section-C

UNIT III PERIPHERALS AND INTERFACING
I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM —Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor 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
1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.
3 Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

Advanced Power Transmission

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC- EE-415G		
Category	Program Elective Course		
Course title	Advanced Power Transmission (Theory)		
Scheme	L	T	P
	3	1	-

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 dc link.

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
1. Rakesh Das Begmudre, Extra High Voltage AC Transmission Engineering, Wiley Estern Limited. 2. K.R. Padiyar, HVDC Power Transmission System, Wiley Estern Limited.
3. E.W. Kimbark. EHV-AC and HVDC Transmission Engineering & Practice, Khanna Publishers.
4. Math H. J. Bollen, Understanding Power Quality Problems: Voltage Sags and Interruptions, Wiley-IEEE Press.
5. Flexible Ac Transmission Systems, Yong-Hua Song, Allan T. Johns, IEE publication
6. Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, Narain G. Hingorani, LaszloGyugyi.

Computer Aided Power System Analysis

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC- EE-417G		
Category	Program Elective Course		
Course title	Computer Aided Power System Analysis (Theory)		
Scheme	L	T	P
	3	1	-

Course Objectives:
1. Understand

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 willhave 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

Load flow analysis: Introduction , classification of buses , representation of transformers , Gauss Seidel iterative method using Ybus , N-R iterative method using Y-bus , approximation to the Jacobian in the NR method, Fast Decoupled L-F method, solution Using Z-bus in the bus frame of reference. Calculation of power.

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.

DIGITAL TECHNIQUES IN FAULT CALCULATIONS: Review of symmetrical components, Sequence networks for synchronous machines, transforms and transmission Lines. Bus Impedance matrix, Algorithm for formulation of Bus. All types of modifications, digital technique in short circuit Studies of: Single line to ground fault, Line to Line fault, Double line to Ground fault and symmetrical fault. Consideration of Pre fault currents.

<div align="center">Section-D.</div>

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

11. Power Systems Engineering by S. K. Gupta, Umesh publication.
12. Power System Analysis & Design with CD by Glover, Cengage Learning.
13. Power System Engg., by B.R.Gupta: S. Chand.
14. Power System Analysis: HadiSaadat, TMH, New Delhi.
15. Computer Techniques in Power System analysis by M. A Pai.
6. Advance power system analysis and dynamics by L.P. Singh: Wiley Eastern ltd.

<div align="center">Intelligent Systems and Control</div>

Theory :	75
Class Work :	25
Total :	100
Duration of Exam:	3 Hrs.

Course Code	OEC-EE-401G		
Category	Open elective course		
Course title	Intelligent Systems and Control		
Scheme	L	T	P
	3	-	-

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.

<div align="center">SECTION-A</div>

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

<div align="center">SECTION-B</div>

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.

<div align="center">SECTION-C</div>

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.

<div align="center">SECTION-D</div>

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:
1. Padhy. N.P.: 'Artificial Intelligence and Intelligent System', Oxford University Press.
2. Kosko; B.: 'Neural Networks and Fuzzy Systems', Prentice-Hall of India Pvt. Ltd.
3. Jacek M. Zurada: 'Introduction to Artificial Neural Systems', Jaico Publishing House.
4. Klir G.J. & Folger T.A.: 'Fuzzy sets; uncertainty and Information', Prentice-Hall of India Pvt. Ltd.
5. Zimmerman H.J.: 'Fuzzy set theory-and its Applications', Kluwer Academic Publishers.
6. Driankov; Hellendroon: 'Introduction to Fuzzy Control', Narosa Publishers.
7. Goldberg D.E.: 'Genetic algorithms in Search; Optimization and Machine learning', Addison Wesley.
8. Stanislaw H. Zak: 'Systems and Control' Oxford University Press.

<div align="center">Renewable Energy and Distributed Generation</div>

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs

Course Code	OEC-EE-403G		
Category	Open Elective Course		
Course title	Renewable Energy and Distributed Generation (Theory)		
Scheme	L	T	P
	3	0	-

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.
3. Know the Impact of Distributed Generation on Power 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.

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

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

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

1. RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies",2nd Ed. Prentice Hall of India ,2011
2. Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July2011,Wiley –IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators",October 2007, Wiley-IEEE Press.
4. RogerA.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
5. JamesF.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Intelligent Systems and Control

Theory :	75
Class Work :	25
Total :	100
Duration of Exam:	3 Hrs.

Course Code	OEC-EE-405G		
Category	Open elective course		
Course title	Intelligent Systems and Control		
Scheme	L	T	P
	3	-	-

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

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.

<div align="center">SECTION-D</div>

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:

9. Padhy. N.P.: 'Artificial Intelligence and Intelligent System', Oxford University Press.
10. Kosko; B.: 'Neural Networks and Fuzzy Systems', Prentice-Hall of India Pvt. Ltd.
11. Jacek M. Zurada: 'Introduction to Artificial Neural Systems', Jaico Publishing House.
12. Klir G.J. & Folger T.A.: 'Fuzzy sets; uncertainty and Information', Prentice-Hall of India Pvt. Ltd.
13. Zimmerman H.J.: 'Fuzzy set theory-and its Applications', Kluwer Academic Publishers.
14. Driankov; Hellendroon: 'Introduction to Fuzzy Control', Narosa Publishers.
15. Goldberg D.E.: 'Genetic algorithms in Search; Optimization and Machine learning', Addison Wesley.
16. Stanislaw H. Zak: 'Systems and Control' Oxford University Press.

Course code	OEC-CE- 448G			
Category	Open Elective Courses (OEC)			
Course title	Traffic Engineering and Road Safety			
Scheme and Credits	L	T	P	**Credits**
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

COURSE OBJECTIVES:

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

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-3: Traffic Accidents: Accident surveys. Causes of road accidents and preventive measures.Capacity and Level of Service.

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

Module-5: Traffic Control Devices: Signs, Signals, markings and islands. Types of signs, Types of signals,Design of Signal, Intersections at grade and grade separated intersections. Types of grades separatedintersections, Parking surveys: On street parking, off street parking.

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.

COURSE OUTCOMES:

After completing this course, students should be able:

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

RECOMMENDED BOOKS:

- Principles of Transportation Engineering by Chakroborty& Das, Prentice Hall, India.
- Highway Engg by S.K.Khanna& C.E.G. Justo, Nem Chand Bros., Roorkee.
- Traffic Engg and Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
- Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd. N.Delhi.

Course code	OEC-ME-410G	
Category	Open Elective Courses (OEC)	
Course title	**QUALITY ENGINEERING**	
Scheme and Credits	L	T	P	**Credits**
	3	0	0	3
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 o TQM, Concepts, Characteristics of TQM, Relevance of TQM, Approaches to TQM Implementation, TQM philosophies, Taguchi Philosphy, JIT, Kaizen, Six Sigma approach, 5-S approach

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, New Delhi
2. Quality Management, Kanishka Bed, Oxford University Press, New Delhi

3. Introduction to SQC, Montgomery DC, 3e, Wiley, New Delhi

4. Fundamentals of quality control and improvement, A Mitra, Mcmillan pub. Company, NY

Reference Books:

1. Fundamentals of Applied Statistics, Gupta and Kapoor, Sultan Chand and Sons, New Delhi.

SOLAR PHOTOVOLTAIC TECHNOLOGY

Theory :		75
Class Work :		25
Total :		100
Duration of Exam :		3 Hrs.

Course Code	OEC- EE-407G		
Category	Open Elective Course		
Course title	SOLAR PHOTOVOLTAIC TECHNOLOGY (Theory)		
Scheme	L	T	P
	3	-	-

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
      To explain basics of solar photovoltaic systems.
      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

GRID CONNECTED PV SYSTEMS: Schematics, Components, Charge Conditioners, Interface Components - Balance of system Components - PV System in Buildings.

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

REFERENCES 1. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications, PHI Learning Pvt. Ltd., 2011.
2. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008.
3. Nelson, J The Physics of Solar Cells. Imperial College Press, 2003. Thomas Markvart, Solar Electricit, John Wiley and Sons, 2001.
4. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish (Editors), Applied Photovoltaics, Earthscan, 2008.
5. Michael Boxwell, The Solar Electricity Handbook, Code Green Publishing, UK, 2009.
6. RikDeGunther, Solar Power Your Home for Dummies, Wiley Publishing Inc, 2008.
7. Photovoltaics: Design and Installation Manual, Published by Solar Energy International.

Energy Conservation and Management

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC- EE-409G		
Category	Open Elective Course		
Course title	Energy Conservation and Management (Theory)		
Scheme	L	T	P
	3	-	-

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 willhave 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
Energy Conservation: Introduction, Motivation for Energy Conservation, Principles of Energy Conservation, Energy Conservation Planning, Energy Conservation in Industries, Electrical Energy Conservation in Small Scale Industries,

Energy Conservation in Electrical Generation, Transmission and Distribution, Energy Conservation in Household and Commercial Sectors, Energy Conservation in Transport, Energy Conservation in Agriculture, Energy Conservation Legislation.

Section-B

Cogeneration: Definition and Scope, Topping and Bottoming Cycles, Benefits, Industries Suitable for Cogeneration, Industrial Suitable for Cogeneration, Agricultural Uses of Waste Heat, Aquacultural Uses of Waste Heat, Use of Power Plant Reject Heat for Waste Water Treatment, Integrated Energy System, Potential of Cogeneration in India.

Section-C

Demand Side Management: Introduction, Scope of Demand Side Management, Evolution of DSM Concept, DSM Planning and Implementation, Load Management as a DSM Strategy, Applications of Load Control, End use Energy Conservation, Tariff Options for DSM, Customer Acceptance, Implementation Issues, Implementation Strategies, DSM and Environment, International Experience with DSM..

Section-D.

Environmental Aspects of Electric Energy Generation: Environment and its Quality, Man's Right to Modify Environment, Energy and Environment, Air Pollution, Stack Emissions, Cooling Tower Impacts, Aquatic Impacts, Nuclear Plant Impacts, Hydro-Plant Impacts, Social and Economic Impacts.

Text / References
1. Gupta B. R.: Generation of Electrical Energy, Eurasia Publishing House Pvt. Ltd., New Delhi, 2001 IV Edition.
2. Durgesh Chandra &: Energy Scope, South Asian Publishers Pvt. Ltd, New Delhi.
3. M.V. Deshpande: Electrical Power System, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. J. Nanda and D.P. Kothari: Recent Trends in Electric Energy Systems, Prentice Hall of India Pvt. Ltd, New Delhi.

Course code	**OEC-CE- 450G**				
Category	OpenElective Course				
Course title	**Disaster Management**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	**0**	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

COURSE OBJECTIVES:

- To provide basic conceptual understanding of disasters and its relationships with development.
- Provide an understanding of the social nature of natural hazards and disasters
- 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, ozone depletion

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:

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423

2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011

Course code	**OEC-ECE-451-G**				
Category	**Open Elective Course**				
Course title	**Electronic Principles**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	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 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
2.Modren Digital Electronics: R.P. Jain; McGraw-Hill

REFERENCE BOOKS: 1.Electronics Principles: Malvino ; McGrawHill
2.Electronics Circuits: Donald L. Schilling & Charles Belove ; McGrawHill
3.Electronics Devices & Circuits: Boylestad & Nashelsky ; Pearson.

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.

Advanced Engineering Mathematics

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs

Course Code	OEC-MATH-405G		
Category	Open Elective Course		
Course title	Advanced Engineering Mathematics (Theory)		
Scheme	L	T	P
	3	0	-

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

1. Operation Research: An Introduction by H. A. Taha, Pearson Prentice Hall Publication.

2. Non linear Programming: Theory & Algorithms by M.S Bazara, H. D. Shorali and C.M Shetty, Johan Wiley & Sons.

3. Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.

4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

Computer Communication

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs

Course Code	OEC-CSE-430G		
Category	Open Elective Course		
Course title	**Computer Communication** (Theory)		
Scheme	L	T	P
	3	0	-

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.

Unit 1

Introduction to Data Communication: Need, components, Data representations communication model, Characteristics of an effective Communication system, Transmission modes: Simplex, Half Duplex and Full Duplex. Serial and parallel transmission. Unicasting, Multicasting, Broadcasting, Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM), Amplitude Shift Keying, Frequency Shift Keying, Phase Shift Keying, **MULTIPLEXING**: FDM, WDM, TDM, packet switching and circuit switching. **Transmission Media**: Copper cable, Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable. Introduction to Computer Network: applications, benefits and problems, Types of Networks: PAN, LAN, MAN and WAN.

Unit 2

Network Topologies: Introduction to Computer Network Topologies: Mesh Topology, Bus Topology, Star Topology, Ring Topology, Tree Topology, Hybrid Topology, Irregular – Topology.

OSI and TCP/IP Model: Layering architecture of networks, OSI model, Functions of each layer, Services and Protocols of each layer

Unit 3

Media Access Control, Random Access: ALOHA, CSMA and CSMA/CD. Controlled Access: Reservation, Polling and Token Passing. Channelization: FDMA, TDMA and CDMA

Ethernet: Features and types of LANs, Types of Ethernets- Thicknet, Thinnet, Fast Ethernet and Gigabit and 10G Ethernet etc. Concept of Carrier Sense Multiple Access (CSMA)/CD in Ethernet,

Network addressing: Physical addressing, logical addressing and port addressing, MAC addressing in Ethernet, IP V4 addressing: concept of subnet, network and host address, IP address Classes- A, B, C, D and E classes. Introduction to classless addressing.

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:

1. Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson publications, 2010.

2. Forouzan, Data Communication and networking ,5th Edition, Tata McGrawHill, 2012.

3. William Stalling, Data & Computer Communication 6th edition, LPE Pearson Education, 2013.

Reference Books:

Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, 2000, Addison Wesley, Low Price Edition.

Computer Networks – A System Approach, Larry L. Peterson & Bruce S. Davie, 2 Edition

Computer Networking – ED Tittel , 2002, T.M.H.

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-08G				
Category	HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)				
Course title	FUNDAMENTALS OF MANAGEMENT				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Objectives:	Students will be able to understand: 1. Evolution of Management and contribution of Management thinkers. 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

UNIT-I

Meaning of management, Definitions of Management, Characteristics of management, Management vs. Administration. Management-Art, Science and Profession. Importance of Management. Development of Management thoughts. Principles of Management. The Management Functions, Inter-relationship of Managerial functions. Nature and Significance of staffing, Personnel management, Functions of personnel management, Manpower planning, Process of manpower planning, Recruitment, Selection; Promotion - Seniority Vs. Merit. Training - objectives and types of training.

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

Introduction of Financial Management, Objectives of Financial Management, Functions and Importance of Financial Management. Brief Introduction to the concept of capital structure and various sources of finance.
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:
1. Principles and Practice of Management - R.S. Gupta, B.D.Sharma, N.S.Bhalla.(Kalyani Publishers)

2. Organisation and Management - R.D. Aggarwal (Tata Mc Graw Hill)

REFERENCES:

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)

2. Management – Harold, Koontz and CyriloDonell (Mc.Graw Hill).

3. Marketing Management – S.A. Sherlikar (Himalaya Publishing House, Bombay).

4. Financial Management - I.M. Pandey (Vikas Publishing House, New Delhi)

5. Management - James A.F. Stoner &R.Edward Freeman, PHI.

Project stage-1

External project marks :	50
Internal project marks:	50
Total :	100
Duration of Exam:	3 Hrs.

Course Code	PROJ-EE-423G		
Category	Professional Core Courses		
Course title	Project stage-I		
Scheme	L	T	P
	-	-	4

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

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

The student will be required to submit two copies of his/her project report to the department for record (one copy each for the department and participating teacher).
The students may be asked to work individually or in a group normally not more than
four –six students in a group(If any large/big projects occurs then strength of students increases
ap per guide supervision). Viva- voce must be based on the preliminary report submitted by
students related to the project.
Course Outcomes:
After completing the course the students will be able to:
1. Develop the professional quality of employing technical knowledge obtained in the field of Engineering & Technology.
2. Design and make analysis augmented with creativity, innovation and ingenuity.
3. Develop an understanding on how to work in actual industry environment.
4. Utilise the technical resources and write the technical report.

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

Sl. No.	Course Code	Course Title	Teaching Schedule			Examination Schedule (Marks)				Credit	Duration of Exam (Hours)
			L	T	P	Mark of Class work	Theory	Practical	Total		
1.	Refer to Table-V	Program Elective –VI	3	1	0	25	75	0	100	4	3
2.	Refer to Table-VI	Open Elective-V	3	0	0	25	75	0	100	3	3
3.	Refer to Table-VII	Open Elective-VI	3	0	0	25	75	0	100	3	3
4.	PROJ-EE-422G	Project Stage-II	0	0	8	50	0	100	150	4	3
5.	SEM-EE-424G	Seminar	0	0	2	50	0	50	100	1	3
6.	GP –EE-426G	General Proficiency	0	0	2			50	50	-	3
		Total							600	15	

TABLE-V
PROGRAM ELECTIVE LIST FOR VIII SEM (Program Elective –VI)

S. No	Course Code	Title of the Course
1.	PEC-EE-402G	Special Electrical Machines
2.	PEC-EE-404G	Applications of Power Electronics in Power Systems
3.	PEC-EE-406G	Power System Stability
4.	PEC-EE-408G	Advanced Control Systems
5.	PEC-EE-410G	Advances in Power Transmission & Distribution

TABLE-VI
OPEN ELECTIVE LIST FOR VIII SEM (Open Elective-V)

S. No.	Course Code	Title of the Course
1	OEC-EE-402G	Solar Thermal Applications
2	OEC-EE-404G	Electrical Safety and Standards
3	OEC-EE-406G	Industrial control
4	OEC-CE-452-G	Elements of Civil Engineering
5	OEC –ME-402G	Operations Research

TABLE-VII

OPEN ELECTIVE LIST FOR VIII SEM (Open Elective-VI)

S. No.	Course Code	Title of the Course
1	OEC-EE-408G	Solar Energy Appliances
2	OEC-EE-410G	Renewable Energy Converters
3	OEC-EE-412G	Robotics
4	OEC-EE-414G	Energy Management and Auditing
5	OEC-ECE-452-G	Intelligent Instrumentation for Engineers

Special Electrical Machines

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC-EE-402G		
Category	Program elective Course		
Course title	Special Electrical Machines		
Scheme	L	T	P
	3	1	-

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, S Chand
2. Electric Machines ,Ashfaq Hussain, Dhanpat Rai
3. Electric Machines: I.J.Nagrath and D.P. Kothari, TMH, New Delhi.
4. Generalized theory of Electrical Machines: P.S. Bhimbra(Khanna Pub.)
5.Electric Machinery, Fitzgerald and Kingsley, MGH.
6. P.C. Sen " Principles of Electrical Machines and Power Electronics" John willey & Sons, 2001
7. G.K.Dubey "Fundamentals of Electric Drives" Narosa Publishing House, 2001.

Applications of Power Electronics in Power Systems

Theory :   75
Class Work :   25
Total :   100
Duration of Exam: 3 Hrs.

Course Code	PEC-EE-404G		
Category	Program Elective Course		
Course title	Applications of Power Electronics in Power Systems		
Scheme	L	T	P
	3	1	-

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. 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. 5. 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.

6. 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:

1. N.G. Hingorani& Laszlo Gyugyi, Understanding FACTS, IEEE Press, 2000.

2. E. F. Fuchs & Mohammad A.S. Masoum, Power Quality in Power Systems and Electrical Machines, Elsevier Academic Press 2008.

3. K.R. Padiyar, FACTS controllers in power transmission and distribution, New Age International publishers, New Delhi, 2007.

4. K.R. Padiyar, HVDC Power Transmission Systems, New Age International publishers, New Delhi, 1999.

Power System Stability

Course Code	PEC- EE-406G		
Category	Program Elective Course		
Course title	Power System Stability (Theory)		
Scheme	L	T	P
	3	1	-

Course Objectives:
1. Understand the general information about power system stability problems.
2. Understand the classification and prevention of different type of stability.
3. Understand the principle of synchronous machines and its modeling.
4. Understand the state space model and state space representation of simplified model of synchronous machine.
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 about the classification of stability.
 2. know power system stability problem.
 3. know about synchronous machine modelling.
 4. how to handle various stability and unstability problem.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 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 Stabikity Problem : 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
Transient Stability : An elementary view of transient stability, numerical integration methods, simulation of power system dynamic response

Section-D.

VOLTAGE Stability : Basic concept related o 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

Advanced Control Systems

Theory :	75
Class Work :	25
Total :	100
Duration of Exam:	3 Hrs.

Course Code	PEC-EE-408G		
Category	Program Elective Course		
Course title	Advanced Control Systems		
Scheme	L	T	P
	3	1	-

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.

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.

State feedback controller design: Controllability & observability. State feed-back design via pole placement technique. Sampled data control system: Pulse Transfer function-Stability of sampled data system -Routh Hurwitz criterion. Introduction to state-space representation of sampled data systems

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:
1. Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.
2. Kuo B.C, Analysis and Synthesis of Sampled Data Systems, Prentice Hall Publications.
3. Nagarath I. J. and Gopal M., Control System Engineering, Wiley Eastern, 2008.
4. Nise N. S., Control Systems Engineering, 6/e, Wiley Eastern, 2010.
5. Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010
6. Alberto Isidori, Nonlinear Control Systems, Springer Verlag, 1995.
7. Gibson J. E., F.B. Tuteur and J. R. Ragazzini, Control System Components, Tata McGraw Hill, 2013
8. Gopal M., Control Systems Principles and Design, Tata McGraw Hill, 2008.
9. Jean-Jacques E. Slotine&Weiping Li, Applied Nonlinear Control, Prentice-Hall., NJ, 1991. C

Advances in Power Transmission & Distribution

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	PEC- EE-410G		
Category	Program Elective Course		
Course title	Advances in Power Transmission & Distribution (Theory)		
Scheme	L	T	P
	3	1	-

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
Basic theory of line compensation. FACTS devices, The FACTS optimisation problem. Transient and dynamic stability enhancement using FACTS components.

Section B
Introduction to Electrical Distribution System, Components of Distribution System Substation and Busbar Layouts, Introduction to distribution automation, Layout of substations and feeders, Optimum siting and sizing of substations.

Section C
Distribution system load flow, configuration of distribution system, optimum capacitor placement. Optimum feeder switching for loss minimization and load control. Distribution system restoration.

Section D
Distribution system monitoring and control: SCADA, Concept of modern distribution systems. Concepts of modern grid.

Text / References
1. Flexible Ac Transmission Systems, Yong-Hua Song, Allan T. Johns, IEE publication
2. Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems, Narain G. Hingorani, LaszloGyugyi.
3. https://nptel.ac.in/courses/108/107/108107112/
4. "Electric Power Distribution system, Engineering" – by TuranGonen, McGraw–hill Book Company.
5. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
6. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
7. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

Solar Thermal Applications

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC- EE-402G		
Category	Open Elective Course		
Course title	Solar Thermal Applications (Theory)		
Scheme	L	T	P
	3	-	-

Course Objectives:
1. To learn the fundamental concepts about solar energy systems and devices
2. To study the performance of each system in detail along with practical case studies

Course Outcomes:
Upon successful completion of the course, students will be able
1. The fundamental concepts about solar energy systems and devices are incorporated.
2. The performance of the systems along with practical case studies were done.

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
Solar Radiation

Solar Radiation Outside the Earth's Atmosphere, Solar Radiation at the Earth's Surface, Instruments for Measuring Solar Radiation and Sunshine, Solar Radiation Data, Solar Radiation Geometry, Empirical Equations for Predicting the Availability of Solar Radiation, Solar Radiation on Tilted Surfaces. Heat transfer concept.

Section B

Solar Energy Collectors:

Liquid Flat-Plate Collectors: General, Performance Analysis, Transmissivity of the Cover System, Transmissivity-Absorptivity Product, Overall Loss Coefficient and Heat Transfer Correlations, Collector Efficiency Factor, Collector Heat-removal Factor, Effects of Various Parameters on Performance, Analysis of Collectors Similar to the Conventional Collector, Transient Analysis, Testing Procedures, Alternatives to the Conventional Collector

Concentrating Collectors:

Introduction, Flat-plate Collectors with Plane Reflectors, Cylindrical Parabolic Collector, Compound Parabolic Collector (CPC), Paraboloid Dish Collector, Central Receiver Collector,

Section C

Thermal Energy Storage:

Introduction, Sensible Heat Storage, Latent Heat Storage, Thermochemical Storage

Section D

Unit 4 Solar Air Heaters and greenhouse drying system

Introduction, Performance Analysis of a Conventional Air Heater, Other Types of Air Heaters, Greenhouse effect, solar drying, types of dryer, drying mechanics.

RECOMMENDED BOOK(S):
1 Solar Energy by S.P. Sukhatme
2 Solar Thermal Engineering by P.J. Lunde
3 Solar Energy by J.S. Hsieh
4 Solar Thermal Engineering Systems by G.N. Tiwari and S. Suneja
5. Solar energy by G.N. Tiwari, Alpha Science, 2002

Electrical Safety and Standards

Theory : 75
Class Work : 25
Total : 100
Duration of Exam : 3 Hrs

Course Code	OEC-EE-404G		
Category	Program Elective Course		
Course title	Electrical Safety and Standards (Theory)		
Scheme	L	T	P
	3	-	-

Course Objectives:

1. To provide a comprehensive exposure to electrical hazards.
2. To understand various grounding techniques and safety procedures
3. To know about various electrical maintenance techniques

Course Outcomes:

At the end of this course, students will demonstrate the ability to
1. Describe electrical hazards and safety equipment.
2. Analyze and apply various grounding and bonding techniques
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Participate in a safety team.
5. Carry out proper maintenance of electrical equipment by understanding various standards.

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

Primary and secondary hazards- arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one line diagram- electrician's safety kit.

Section-B

General requirements for grounding and bonding- definitions- grounding of electrical equipment bonding of electrically conducting materials and other equipment-connection of grounding and bonding equipment- system grounding- purpose of system grounding- grounding electrode system grounding conductor connection to electrodes- use of grounded circuit conductor for grounding equipment- grounding of low voltage and high voltage systems.

Section-C

The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment , procedure for low, medium and high voltage systems- the one minute safety audit Electrical safety programme structure, development- company safety teamsafety policy programme implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation

Section-D

Safety related case for electrical equipments, Various Standards : IEEE, IEC, IS... ,regulatory bodiesnational electrical safety code- standard for electrical safety in work place- occupational safety and health administration standards, Indian Electricity Acts related to Electrical Safety.

Text / References

1. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield ,'Electrical Safety Handbook', McGraw-Hill Education, 4thEdition, 2012.
2. 2. Sunil S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety management", Khanna Publishers. New Delhi, 1988.
3. 3. Maxwell Adams.J, 'Electrical Safety- a guide to the causes and prevention of electric hazards', The Institution of Electric Engineers, IET 1994.
4. 4. Ray A. Jones, Jane G. Jones, 'Electrical Safety in the Workplace', Jones & Bartlett Learning, 2000.

Industrial Control

Theory :	75
Class Work :	25
Total :	100
Duration of Exam:	3 Hrs.

Course Code	OEC-EE-406G		
Category	Open Elective Course		
Course title	Industrial Control		
Scheme	L	T	P
	3	-	-

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:

- To learn the fundamental of control of most process variables and how these measured quantities are transformed and transmitted.
- To learn the concepts of process control, including principles of industrial practices and computer control.
- To apply these concepts to the control system for typical chemical processes.
- To gain knowledge and actions of various types of control system, including analog and digital types, online and real time.

Course Outcomes:
At the end of this course, students will be able to:
- Understand the basic principles & importance of process control in industrial process plants.
- Specify the required instrumentation and final elements to ensure that well-tuned control is achieved.
- Understand the use of block diagrams & the mathematical basis for the design of control systems.
- Design and tune process (PID) controllers.
- Use appropriate software tools (e.g.Matlab Control Toolbox & Simulink) for the modelling of plant dynamics and the design of well tuned control loops.
- Understand the importance and application of good instrumentation for the efficient design of process control loops for process engineering plants.
- Draw a PID (Process & Instrumentation Diagram) & devise simple but effective plant wide control strategies using appropriate heuristics.

SECTION-A

Introduction to Process Control System: Control objectives and configurations of process control, role of control engineer, documentation, process equipments and use, process control operations. Mathematical modelling: Type of models; modelling procedure steps, empirical model identification and system identification.

SECTION-B

DYNAMICAL MODELLING AND FEED BACK CONTROL
Blending process: problem, dynamics, modelling, selection, temperature sensors, concentration response of isothermal CSTR with no chemical reaction, first order reaction, higher order reaction, pressure tanks with resistances, change in valve positions, interacting systems, liquid level systems with linear/non linear effects; non-interacting and interacting tanks. Feedback Control Analysis: Transient response with regulatory, set-point and tracking control for second and higher order systems with P, PI, PD, PID controllers, effect of measurement lag and process dead time on response, control architectures.

SECTION-C

ENHANCED CONCEPTS OF PROCESS CONTROL
Enhance control strategies: PID controller tuning, control valves, feed forward control, cascade control, selectors and redundant control, concept of computer control, sequential, supervisory and DDC modes, digital implementation of PID, computer control architecture. Advanced control strategies: Model predictive control, dead time compensation,

internal model control, adaptive control, inferential, statistical control, intelligent control (ANN, Fuzzy), case studies.

SECTION-D

COMMUNICATION AND NETWORKING

Background: organization, bus interface, type of buses, features, factors to reckon, LAN topologies, communication hierarchy, ISO reference model, data link layer, central and decentralized bus control, industrial communication systems, management protocols, comparison. Industrial visits: Seminars/Workshop

Text / Reference Books:

1. Peter Harriot, Process control, McGrow Hill, Edition No. 01, 1964.
2. D. E. Seborg, T. F. Edgar, D. A. Mellichamp, F. J. Doyle, Process Dynamics and Control, Wiley, Edition No. 04, 2016.
3. S. K. Singh, Computer Aided process control, PHI, Edition No. 01, 2004.
4. S. Bhanot, Process Control-Principles and Applications, Oxford University Press, Edition No. 04, 2010.
5. T. E. Marlin, Process Control: Designing Processes and Control Systems for Dynamic Performance, McGrow Hill, Edition No. 02, 2000.

Elements of Civil Engineering

Course code	OEC-CE-452-G				
Category	Open Elective Course				
Course title	**Elements of Civil Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**0**	**0**	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

COURSE OBJECTIVES:

- To carry out simple land survey to prepare maps with existing details.
- To understand building plan elevation and section.
- To get familiar with construction materials.
- To know the basics of soil mechanics and environmental engineering.
- To get acquainted with transportation systems.

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 CONTENT

Unit-I

Introduction: Branches of Civil Engineering, Scope of Civil Engineering, Role of Civil Engineer in Society. Impact of infrastructural development on economy of country.

Surveying: Definition of Surveying, Aims and applications, Fundamental principles of surveying, Classification of surveying, basic introduction to Instruments used in chain surveying and levelling, Contour and its Characteristics.

Unit-II

Building Materials and Construction: Introduction to construction materials, Classification of buildings, Types of loads acting on buildings, Building components and their functions and nominal dimensions.

Estimating and valuation: Purpose of estimating and valuation, Principle of estimation, unit of measurement, item work, Estimation of quantity of load bearing structure with single room & two rooms, Tenders and Contracts, Purpose of valuation

Unit-III

Fluid Mechanics: Distinction between a fluid and a solid; Fluid properties, Fluid Statics: Pressure density height relationship, Buoyancy and stability of floating bodies, Fluid Kinematics: types of flows, Basics of open channel flow.

Soil Mechanics: Types of Soil, Three Phase System, Index Properties, Sieve Analysis, Compaction and Consolidation Process, Types of Lateral Earth Pressure, soil exploration, basic introduction to types of foundations.

Unit-IV

Environmental Engineering: Sources of water, water demand, water and waste water characteristics, basic introduction to water treatment, sewage, sewerage system, types of sewers, sludge and its disposal.

Transportation Engineering: Modes of transportation, History of Road Development, RoadDevelopment Plans in India, Classification of Highways, Road Patterns. Introduction to road traffic and traffic control.

Course Outcome:

After learning the course, the students shall be able to:

- Carry out simple land survey to prepare maps with existing details.

- Understand building plan elevation and section.
- Get acquainted with construction materials types of flow.
- Get acquainted with soil mechanics and environmental engineering.
- Get acquainted with transportation systems.

Course code	OEC –ME-402G				
Category	Open Elective Courses (OEC)				
Course title	**OPERATIONS RESEARCH**				
Scheme and Credits	L	T	P	**Credits**	
	3	0	0	3	
Objectives:	The aims of operation research include: solving operational questions, solving questions related to resources' operations, and solving decision-making questions. Operational research has a relation with different areas of study and it has several applications. Operation research is considered as a tool of productivity. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas.				
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.

UNIT-I

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex GaussJordan reduction process in simplex methods, BIG-M methods computational, problems.

UNIT-II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

UNIT-III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

UNIT-IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Decision Theory: Decision process, SIMON model types of decision making environment-certainty, risk, uncertainty, decision making with utilities, problems.

Course Outcomes (COs): At the end of the course, the student shall be able to:

CO 1- Discuss the role of operations research in decision-making, and its applications in industry and should be able to formulate and design real-world problems through models & experiments.

CO 2- Knowledge of various types of deterministic models like linear programming, transportation model etc.

CO 3- Explore various types of stochastic models like waiting line model, project line model, simulation etc.

CO 4- Deduce the relationship between a linear program and its dual and perform sensitivity analysis.

CO 5- Describe different decision making environments and apply decision making process in the real world situations

Text Books:

1) Operation Research – TAHA, PHI, New Delhi.

2) Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.

Reference Books :

1) Operation Research- Gupta & Sharma, National Publishers, New Delhi.

2) Quantitative Techniques- Vohra, TMH, New Delhi 8. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.

3) Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.

4) Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

SOLAR ENERGY APPLIANCES

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs.

Course Code	OEC- EE-408G		
Category	Open Elective Course		
Course title	SOLAR ENERGY APPLIANCES (Theory)		
Scheme	L	T	P
	3	-	-

Course Objectives:
    1. To learn the fundamental concepts about solar energy systems and devices

2   To study the performance of each system in detail along with practical case studies

Course Outcomes:
Upon successful completion of the course, students will be able
1. The fundamental concepts about solar energy systems and devices are incorporated.
2. The performance of the systems along with practical case studies were done.

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
SOLAR LIGHTING: Solar cell – Working principle of a solar cell – Solar home lighting systems – Solar street lighting systems - Solar lanterns – Applications - Rural electrification process – Case studies.
Section-B
SOLAR COOKING: Introduction – Types of solar cookers – Advantages and disadvantages - Box type – Parabolic dish cooker - Performance evaluation of solar cookers – Testing of a solar cooker – Applications of solar cooking - Case studies
Section-C
SOLAR DRYING Introduction – Need for solar drying - Basics of solar drying – Types of solar dryers – Direct type solar dryer – Mixed mode type solar dryer – Forced circulation type dryers – Hybrid dryer – Bin type dryer – Solar timber drying – Applications - Case studies.
Section-D
SOLAR DESALINATION: Introduction – Necessity for desalination – Study on various desalination techniques – Comparison between conventional and solar desalination – Basics of solar still - Simple solar still – Material problems in solar still – Solar disinfection and its methods – Case studies on various desalination techniques.
REFERENCES
1. Suhatme and Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill, 2008.
2. HP Garg and J Prakash: Solar Energy: Fundamentals and Applications, Tata McGraw Hill, 2010.
3. Rai, G.D., Solar Energy Utilization, Khanna Publishers,Delhi, 2010.
4. Michael Grupp, Time to Shine: Applications of Solar Energy Technology, John Wiley & Sons, 2012.
5. SM Sze, Kwok K Ng: Physics of semiconductor devices, third edition, John Wiley & Sons, 2007. 6. Daniel J. O'Connor, 101 patented solar energy uses,VanNostrand Reinhold Co., 2007.
7. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008

Renewable Energy Converters

Theory :	75
Class Work :	25
Total :	100
Duration of Exam :	3 Hrs

Course Code	OEC-EE-410G		
Category	Open Elective Course		
Course title	Renewable Energy Converters (Theory)		
Scheme	L	T	P
	3	0	-

Course Objectives:

1. To understand about various advanced power converters.
2. To analyze and design different power converter circuits used in renewable energy systems.

Course Outcomes:

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

1. Understand advanced concepts in power electronics.
2. Adaptability to analyze power converter based renewable energy systems.
3. To troubleshoot gird compatibility issues with power electronics circuits.

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 Review of 2-pulse and 6-pulse converters and their performance with inductive and capacitive loads. Harmonic analysis of single-phase and three-phase converters.

Section-B

Power Converters for Solar PV Systems, Multi-level converters, topologies and control techniques, PWM techniques.

Section-C

Power Converters for Fuel Cells Buck converter, Boost converter, Interleaved buck/boost converter, advanced modulation techniques.

Section-D

Power Converters in WECS Multi-channel interleaved boost converters, voltage source converters, control of grid-tied converters, matrix converter, and modular multi level inverters.

Text / References

1. V. Yaramasu and B.Wu, "Model Predictive Control of Wind Energy Conversion Systems," Wiley- IEEE Press, 2016.
2. Rashid M. H., "Power Electronics Circuits Devices and Applications", 3rd Ed., Pearson Education, 2008.
3. Lander Cyril W., "Power Electronics", Prentice Hall of India Private Limited, 2004.
4. Mohan N., Undeland T.M. and Robbins W.P., "Power Electronics-Converters, Applications and Design", 3rd Ed., Wiley India, 2008.
5. Paice D. A., "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE press, 1995.

Robotics

Theory : 75
Class Work : 25
Total : 100
Duration of Exam: 3 Hrs.

Course Code	OEC-EE-412G		
Category	Open Elective Course		
Course title	Robotics		
Scheme	L	T	P
	3	-	-

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:

- To be familiar with the robotic and brief history of robot and applications.
- To give the student familiarities with the kinematics and dynamics of robots.
- To give knowledge about robot end effectors and their design.
- To understand the control strategies for Robotic applications.

Course Outcomes:

At the end of this course,

- Students will be equipped with brief history of Robotic and application.
- Students will be familiarized with kinematic motion of robot.
- Student will be acquainted with the basic theory required for solving control problem in Robotics.
- Students will be conversant to advance control strategies for Robotic applications.

SECTION-A

Introduction – Components and Structure of Robotic System.

SECTION-B

Rigid Motions and Homogeneous Transformations. Kinematics – forward Kinematics, Inverse Kinematics and its solution.

SECTION-C

Dynamics: Formulation of Dynamic equation, linearization. Trajectory generation. Independent Joint Control, Multivariable Control.

SECTION-D

Advanced control for Robot Applications.

Text / Reference Books:

1. J.J. Craig, Introduction to Robotics – Mechanics A Control. Addison Wesley.
2. A.J. Koivo, Fundamentals for Control of Robotic Manipulation, John Wiley Inc. New York.
3. Spong and Vidyasagar, Robot Dynamics and Control, John Wiley and Sons.
4. Sciavicco&Siciliano, Modeling and Control of Robot Manipulators, McGraw Hill International Edition.

Energy Management and Auditing

Theory :	75
Class Work :	25
Total :	100
Duration of Exam:	3 Hrs.

Course Code	OEC-EE-414G		
Category	PROGRAM ELECTIVE COURSE		
Course title	Energy Management and Auditing		
Scheme	L	T	P
	3	-	-

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:

- To illustrate the concept energy management.
- To introduce to energy audit study.
- To study the basics of electrical energy management.

Course Outcomes:

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

- Understand the fundamentals of energy management systems.
- Carry out various energy audit processes.
- Describe methods to improve efficiency of electrical energy systems.
- Asses the use of alternative energy sources in improving the energy management.

SECTION-A

Introduction: Introduction to energy management, Organizational Structure, Energy Policy and planning

SECTION-B

Energy Auditing: Introduction, Energy Auditing Services, Basic Components of an Energy Audit, Specialized Audit Tools, Industrial Audits, Commercial Audits, Residential Audits, Indoor Air Quality and basics of economic analysis.

SECTION-C

Electric Energy Management: Introduction, Power Supply Effects of Unbalanced Voltages on the Performance of Motors, Power Factor, Electric motor Operating Loads, Determining Electric Motor Operating Loads, Power Meter, Slip Measurement, Electric Motor Efficiency, Sensitivity of Load to Motor RPM, Theoretical Power Consumption, Motor Efficiency Management, Motor Performance Management Process

SECTION-D

Alternative Energy: Introduction, Solar Energy, Wind Energy and other renewable resources for energy management.

Text / Reference Books:

1. Wayne C. Turner, Steve Doty, Energy Management Handbook, The Fairmont Press, Inc.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, Guide to Energy Management, CRC Press.

Course code	**OEC-ECE-452-G**				
Category	**Open Elective Course**				
Course title	**INTELLIGENT INSTRUMENTATION FOR ENGINEERS**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	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 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 intelligent instrumentation.
2. Understand Interfacing of Instruments with computer.

3. Understand the software filters.

UNIT 1. INTRODUCTION: Definition of an intelligent instrumentation system; feature of intelligent instrumentation; components of intelligent instrumentation; Block diagram of an intelligent instrumentation.

UNIT 2. INTERFACING INSTRUMENTS & COMPUTERS: Basic issue of interfacing; Address decoding; Data transfer control; A/D converter; D/A converter; Other interface consideration.

UNIT 3. INSTRUMENTATION/ COMPUTER NETWORKS: Serial & parallel interfaces; Serial communication lines; Parallel data bus; EEE 488bus; Local area networks (LANs): Star networks, Ring &bus networks, Fiber optic distributed networks, Field bus; Communication Protocols for very large systems: communication network rationalization.

UNIT 4. SOFTWARE FILTERS: Description of Spike Filter, Low pass filter, High pass filter etc.

TEXT BOOK: Principles of measurement & Instrumentation: Alan S. Moris; PHI

Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. Understand the intelligent instrumentation.
2. Can Interfacethe Instruments with computer.

Project stage-1I

External Project Marks:	100
Internal Project Marks:	50
Total :	150
Duration of Exam:	3 Hrs.

Course Code	PROJ-EE-424G		
Category	Professional Core Courses		
Course title	Project stage-1I		
Scheme	L	T	P
	-	-	8

The object of Project stage-II is to enable the student to extend further the investigative study taken up under Project stage-I, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership.
The assignment to normally include:
1. In depth study of the topic assigned in the light of the Report prepared under project stage-I;

2. Review and finalization of the Approach to the Problem relating to the assigned topic;

3. Preparing an Action Plan for conducting the investigation, including team work;

4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;

5. Final development of product/process, testing, results, conclusions and future directions;

6. Preparing a paper for Conference presentation/Publication in Journals, if possible;

7. Preparing a Dissertation in the standard format for being evaluated by the Department.

8. Final Seminar Presentation before a Departmental Committee.

SEMINAR

External Seminar Marks:	00
Internal Seminar Marks:	50
Total :	50
Duration of Exam:	3 Hrs.

Course Code	SEM-EE-426G		
Category	Professional Core Courses		
Course title	SEMINAR		
Scheme	L	T	P
	-	-	2

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.

General Proficiency

Marks:	50
Total :	50
Duration of Exam:	3 Hrs.

Course Code	GP-EE-426G		
Category	Professional Core Courses		
Course title	General Proficiency		
Scheme	L	T	P
	-	-	2

The purpose of this course is to inculcate a sense of professionalism in a student along with personality development in terms of quality such as receiving, responding, temperament, attitude and outlook. The student efforts will be evaluated on the basis of his/ her performance / achievements in different walks of life.

The student will present before the committee his/her achievements during the current academic session in the form of a written report highlighting followings:

   I.   Academic Performance --------
   II. Extra Curricular Activities / Community Service, Hostel Activities (10 Marks)
   III. Technical Activities / Industrial, Educational tour /Membership of Professional Societies (10 Marks)
   IV. Sports/games (5 Marks)
   V.   Performance in Viva voce before the committee(25Marks)

The evaluation of this course will be made by the following Committee.

1 Coordinator of the Department or other Faculty Member of the Department

2 External Examiner to be appointed by the University