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 AND ELECTRONICS ENGINEERING) SEMESTER-VII

Sl. No.	Course Code	Course Title	Teaching Schedule L	T	P	Examination Schedule (Marks) Mark of Class work	Theory	Practical	Total	Credit	Duration of Exam (Hours)
1.	Refer to Table-1	Program Elective -IV	3	1	0	25	75	0	100	4	3
2.	Refer to Table-1	Program Elective -V	3	1	0	25	75	0	100	4	3
3.	Refer to Table-II	Open Elective-III	3	0	0	25	75	0	100	3	3
4.	Refer to Table-II	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									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.

TABLE-1
PROGRAM ELECTIVE LIST

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	Modelling and Analysis of Electrical Machines
6.	PEC-EE-411G	Microcontroller Based System Design

7.	PEC-EE-413G	Advanced Power Transmission
8.	PEC-EE-415G	Power System Planning and Reliability
9.	PEC-EE-417G	Computer Aided Power System Analysis
10.	PEC-EEE-419G	Microwave & Radar Engineering
11.	PEC-EEE-421G	Digital System Design
12.	PEC-EEE-423G	Mobile Communication

TABLE-2
OPEN ELECTIVE LIST FOR VII SEM

S. No.	Course Code	Title of the Course
1	OEC-EE-401G	Computer Architecture and Organization
2	OEC-EE-403G	Renewable Energy and distributed generation
3	OEC-EE-405G	Advanced Engineering Mathematics
4	OEC-EE-407G	Intelligent Systems & Control
5	OEC-EE-409G	Energy Conservation and Management
6	OEC-EE-411G	Reliability engineering
7	OEC-EE-413G	Modelling and Simulation
8	OEC-EE-415G	Solar Photovoltaic Technology
9	OEC-EE-417G	Disaster management
10	OEC-EE-419G	Micro Electro Mechanical systems
11	OEC-EEE-421G	Advance Microprocessor
12	OEC-EEE-423G	**Industrial Automation**

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

Sl. No.	Course Code	Course Title	Teaching Schedule L	T	P	Examination Schedule (Marks) Mark of Class work	Theory	Practical	Total	Credit	Duration of Exam (Hours)
1.	Refer to Table-III	Program Elective – VI	3	1	0	25	75	0	100	4	3
2.	Refer to Table-IV	Open Elective-V	3	0	0	25	75	0	100	3	3
3.	Refer to Table-IV	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-	Seminar	0	0	2	50	0	50	100	1	3

	EE-424G										
6.	GP –EE-426G	General Proficiency	0	0	2			50	50	-	3
Total									600	15	

TABLE-3
PROGRAM ELECTIVE LIST FOR VIII SEM

S. No.	Course Code	Title of the Course
1.	PEC-EE-402G	Special Electrical Machines
2.	PEC-EE-404G	Electrical Safety and Standards
3.	PEC-EE-406G	Electrical Energy Conservation and Auditing
4.	PEC-EE-408G	Advanced Control Systems
5.	PEC-EE-410G	Advances in Power Transmission & Distribution
6.	PEC-EE-412G	Power System Stability
7.	PEC-EE-414G	Applications of Power Electronics in Power Systems
8.	PEC-EEE-416G	Image Processing
9.	PEC-EEE-418G	Artificial Intelligence and Expert system
10	PEC-EEE-420G	Software Engineering

TABLE-IV
OPEN ELECTIVE LIST FOR VIII SEM

S. No.	Course Code	Title of the Course
1	OEC-EE-402G	Optimization Theory
2	OEC-EE-404G	Virtual Instrumentation
3	OEC-EE-406G	Solar Thermal Applications
4	OEC-EE-408G	Renewable Energy Converters
5	OEC-EE-410G	Intelligent Instrumentation
6	OEC-EE-412G	Solid & Hazardous waste management
7	OEC-EE-414G	Robotics
8	OEC-EE-416G	Industrial control
9	OEC-EE-418G	Solar Energy Appliances
10	OEC-EEE-420G	OP-Amp Application

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& DomKundwar, A Course in Power Plant Engineering, Pub.: DhanpatRai Pub, 2000.
3. Jain &BalaSubranmanyam, "Power Plant Engineering", DhanpatRai Pub.,
4. Butter Worth, A.B. Gill, "Power Plant Performance Management", Pub: 1984.
5. P.C. Sharma, "Power Plant Engineering", DhanpatRai 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, DhanpathRai, 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.

SECTION-D

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

Text / Reference Books:

1. R. S. Ramshaw, "Power Electronics Semiconductor Switches", Champman& Hall, 1993.
2. N. Mohan, T. M. Undeland and W. P. Robbins, "PowerElectronics, Converter, Application and Design", Third Edition, John Willey & Sons, 2004.
3. M. H. Rashid, "Power Electronics, circuits, Devices andApplications", 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 FrequencyDrive", Standard Publishers Distributors, 2000.
8. Bin Wu, "High-Power Converters and AC Drives", IEEEPress, A John Wiley & Sons, Inc Publication, New York,2006.
9. G. T. Heydt, "Electric Power Quality", Stars in a CirclePublications, 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

Modeling and Analysis of Electrical Machines

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

Course Code	**PEC-EE-409G**		
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 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.

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 electricalmachines.

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-411G		
Category	Program Elective Course		
Course title	Microcontroller Based System Design (Theory)		
Scheme	**L**	**T**	**P**
	3	1	**-**

Course Objectives:

1. Understand

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 – Simple Operations.

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 Systemon 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-413G		
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 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

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.

Power Systems Planning&Reliability

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

Course Code	PEC- EE-415G		
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 will have 6 parts of 2.5 marks from all units and remaining eight questions have to be set by taking two Questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A

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

Section-B

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)

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:

2. 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

4. To understand the solution methods and techniques used in power system studies

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

Section-A

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

Section-B

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.

Section-D.

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

Text / References

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.

MICROWAVE ENGINEERING

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

Course Code	**PEC-EEE-419G**		
Category	**Program Elective Course**		
Course title	**MICROWAVE ENGINEERING**		
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:

After learning the course the students shall be able to:

1 Understand basic concepts and applications of microwave systems.
2 Design, analyze and solve problems related to microwave transmission lines.
3 Design, analyze and solve problems related to microwave waveguide.
4 Analyze, test and use various passive microwave components for different applications.
5 Design and implement the microwave layouts.
6 Design and implement the microwave amplifier, oscillator, and mixer circuits

Section A

MICROWAVE GENERATORS: Construction, characteristics, operating principle and typical applications of Klystron, Reflex Klystron, magnetron and Traveling Wave Tube

Section B

SOLID STATE MICROWAVE DEVICES: Parametric amplifiers, GUNN effect Devices, IMPATT, TRAPATT, BARITT diodes

MICROWAVE RESONATORS: rectangular, cylindrical, spherical and coaxial resonators, excitation and coupling of cavities.

Section C

MATRIX DESCRIPTION OF MICROWAVE CIRCUITS: Scattering matrix-its properties, measurement of scattering coefficients, scattering matrices for common microwave systems.

Section D

MICROWAVE COMPONENTS: Waveguide tees- E-plane, H-plane, magic tee, rat race, directional coupler, tuning screws and stubs, isolators and circulators-their constructional features, and applications. Microwave filters, Phase shifters, attenuators, Wavemeters.

MICROWAVE MEASUREMENTS: Measurement of frequency, impedance (using slotted section) attenuation, power, dielectric constant, measurement of V.S. W. R., insertion loss and permeability.

Text / Reference Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Prentice-Hall of India.
2. David M. Pozar, Microwave Engineering, John Wiley and sons Inc.
3. Das, Annapurna &Sisir K. Das, Microwave Engineering, Tata McGraw-Hill.

Digital System Design

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

Course Code	**PEC-EEE-421G**

Category	**Program Elective Course**		
Course title	**Digital System Design**		
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:

After learning the course the students shall be able to:

1. Adequate knowledge in digital system design concepts.
2. Ability to design and implement digital circuits under realistic constraints and conditions.
3. Ability to debug, verify, simulate, synthesize digital circuits.
4. Ability to devise, select, and use modern techniques and tools needed for digital system design.
5. Evaluate combinational and sequential logic designs using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power
6. Using Verilog, implement a substantial digital system on an FPGA.
7. Learn how to write test-benches and perform verification of the relatively complex digital system.

SECTION A

INTRODUCTION : Introduction to Computer-aided design tools for digital systems. Hardware description languages; introduction to VHDL, data objects, classes and data types, Operators, Overloading, logical operators.Types of delays Entity and Architecture declaration. Introduction to behavioural, dataflow and structural models.

VHDL STATEMENTS : Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modelling, component declaration, structural layout and generics.

SECTION B

COMBINATIONAL CIRCUIT DESIGN: VHDL Models and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc.

SEQUENTIAL CIRCUITS DESIGN : VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters etc.

SECTION C

DESIGN OF MICROCOMPUTER : Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL

SECTION D

DESIGN WITH CPLDs AND FPGAs : Programmable logic devices : ROM, PLAs, PALs, GAL, PEEL, CPLDs and FPGA. Design implementation using CPLDs and FPGAs

Text / Reference Books:

1. IEEE Standard VHDL Language Reference Manual (1993).
2. Digital Design and Modelling with VHDL and Synthesis : KC Chang; IEEE Computer Society Press.
3. "A VHDL Primmer :Bhasker; Prentice Hall 1995.
4. Digital System Design using VHDL : Charles. H.Roth ; PWS (1998).

5. "VHDL-Analysis & Modelling of Digital Systems :Navabi Z; McGraw Hill.
6. VHDL-IV Edition :Perry; TMH (2002)
7. Introduction to Digital Systems :Ercegovac. Lang & Moreno; John Wiley (1999).
8. Fundamentals of Digital Logic with VHDL Design : Brown and Vranesic; TMH (2000)
9. Modern Digital Electronics- III Edition: R.P Jain; TMH (2003).

MOBILE COMMUNICATION

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

Course Code	**PEC-EEE-423G**		
Category	**Program Elective Course**		
Course title	**MOBILE COMMUNICATION**		
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 be able to

1. Design appropriate mobile communication systems.
2. Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
3. Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
4. Analyze path loss and interference for wireless telephony and their influences on a mobilecommunication system's performance.
5. Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
6. Understanding upcoming technologies like 3G, 4G etc.

Section A

Radio Propagation Characteristics, Models for Path loss, Shadowing & Multipath fading-delay spread, Coherence bandwidth, Coherence Time, Doppler Spread Jake's Channel model.

Section B

Digital Modulation for Mobile radio, Analysis under fading channel, diversity techniques and Rake demodulator. Introduction to Spread Spectrum Communication Multiple Access Techniques used in Mobile Wireless Communications: FDMA/TDMA/CDMA.

Section C

The Cellular concept, Frequency Reuse basic theory of hexagonal cell layout, spectrum efficiency, FDM/TDM, Cellular System, channel allocation schemes, Handover Analysis, cellular CDMA, Soft capacity, Erlang capacity comparison.

Section D

Wireless standards-GSM, IS-95, UMTS-IMT-2000, Signaling, Call Control, Mobility Management and location Tracing.

Text / Reference Books:

1. Theodore S.Reppeport, Wireless Communications Principles and Practice, IEEE Press, Prentice Hall.
2. William C.Y.Lec, Mobile Cellular Telecommunications, Analog and Digital Systems, Mc-Graw Hill Inc
3. KamiloFeher, Wireless Digital Communications, Modernization & Spread Spectrum Applications, Prentice Hall of India, New Delhi.
4. KavehPahlavan and Allen H. Levesque " Wireless Information Networks", Wiley Series, John Wiley and Sons Inc.

Computer Arechetechure and Organization

Theory : 75
Class Work : 25

Total : 100
Duration of Exam : 3 Hrs.

Course Code	OEC- EE-401G		
Category	OPEN Elective Course		
Course title	Computer Arechetechure and Organization (Theory)		
Scheme	**L**	**T**	**P**
	3	0	-

COURSE OBJECTIVES: 1. Discuss the basic concepts and structure of computers.
2. Understand concepts of register transfer logic and arithmetic operations.
3. Explain different types of addressing modes and memory organization.
4. Learn the different types of serial communication techniques.
5. Summarize the Instruction execution stages

COURSE OUTCOMES: 1. Understand the theory and architecture of central processing unit.
2. Analyze some of the design issues in terms of speed, technology, cost, performance.
3. Design a simple CPU with applying the theory concepts.
4. Use appropriate tools to design verify and test the CPU architecture.
5. Learn the concepts of parallel processing, pipelining and interprocessor communication.
6. Understand the architecture and functionality of central processing unit.
7. Exemplify in a better way the I/O and memory organization.
8. Define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.

SECTION A

Introduction: Function and structure of a computer, Functional components of a computer, Interconnection of components, Performance of a computer.

SECTION B

Representation of Instructions Representation of Instructions: Machine instructions, Operands, Addressing: Machine instructions, Operands, Addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures.

Processing Unit: Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit - Operations of a control unit, Hardwired control unit, Micro programmed control unit.

SECTION C

Memory Subsystem: Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal Organization of a memory chip, Organization of a memory unit, Error correction memories, Interleaved memories, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit - Concept of virtual memory, Address translation, Hardware support for memory management.

SECTION D

Input/output Subsystem: Access of I/O devices, I/O ports, I/O control mechanisms - Program controlled I/O Interrupt controlled I/O and DMA controlled I/O I/O interfaces Program controlled I/O, Interrupt controlled I/O, and DMA controlled I/O, I/O interfaces - Serial port, Parallel port, PCI bus, SCSI bus, USB bus, Firewall and Infiniband, I/O peripherals - Input devices, Output devices, Secondary storage devices.

References 1

. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGrawHill, 2002.

2. W. Stallings, "Computer Organization and Architecture - Designing for Performance", Prentice Hall of India, 2002.

3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann,1998.

4. J .P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998

Renewable Energy and Distributed Generation

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.

Section-A

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. Ranjan Rakesh, 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", July 2011, Wiley – IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators",October 2007, Wiley-IEEE Press.
4.Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
5.James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

Advanced Engineering Mathematics

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

Course Code	OEC-EE-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.

Intelligent Systems and Control

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

Course Code	OEC-EE-407G		
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.

SECTION-D

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

Text / Reference Books:

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.

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:

3. Understand

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.

Reliability Engineering

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

Course Code	OEC-EE-411G		
Category	Open Elective Course		
Course title	Reliability Engineering		
Scheme	**L**	**T**	**P**
	3	-	-

Course Objectives:

1. Understand

    1. Understand the probability analysis to evaluate reliability
    2. Understand the reliability function, network modeling.
    3. Understand the methods to evaluate, to increase, to optimize reliability.
    4. Understand Concept of maintainability & availability

Course Outcomes:

At the end of this course, students will demonstrate the ability to Explain the concept of probability.

1. Calculate random variable, density & distribution function.
2. To analyze the failure modes & effects.
3. Evaluate reliability functions.
4. Describe various methods to evaluate, increase and allocate and optimize reliability of physical systems.
5. To draw reliability logic diagrams, fault trees, market graphs and find reliability using these

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 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

Introduction: Reliability and its importance, mortality curve, hazard rate, causes of failures, modes of failure,general reliability function and other reliability functions. Mean time to failure (MTTF), repair rate,mean-time-between failures (MTBF), availability, uptime, downtime. Failure frequency and failure distributions..

Section-B

Reliability models – Statistical, structural, Markov, and fault tree. Reliability evaluation using various models.

Section-C

Redundancy techniques: Reliability allocation and Redundancy optimization.

Section-D.

Reliability Testing.

Basic principles of maintainability, availability and security.Availability evaluation using Markov Technique. Basic concepts of fuzzy reliability, failure frequency and loss of load probability

Text / References

1. E. Balaguruswamy, "Reliability *Engineering*", Tata McGraw-Hill Education.
2. KK Aggarwal, "*Reliability Engineering*", Springer.
3. Martin L. Shooman, "*Probabilistic Reliability-An Engineering approach*" , Krieger Publishing Company.
4. Ram Kumar, "*Reliability Engineering*".
5. A.K. Govil, "*Reliability Engineering*", McGraw-Hill Inc.,US

Modelling and Simulation

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

Course Code	OEC- EE-413G		
Category	Open Elective Course		
Course title	**Modelling and Simulation** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	-

Course Objectives:

1. To introduce students the complexities of the real life problems and their solution with stochastic modeling and comprehensive simulations.
2. To introduce learner the fundamental principles of simulation in both deterministic and • stochastic frameworks.

Course Outcomes:

Upon successful completion of the course, students will be able to

1. Look engineering system from the point of view of stochastic framework
2. Model various systems from multiple domains e.g. electrical engineering, bio-informatics, financial systems etc.

3. Undertake further industrial and research assignments.

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

Review of Probability and Random Number generation. Generating continuous and discrete time random variables. Discussions on deterministic and stochastic modeling of engineering systems. Need for stochastic models. Ideas of model validation.

Section-B

Modeling of systems as discrete event systems(DES). Continuous time and discrete time Markov chains, Properties of DES (observability and controllability), Supervisory control of DES, Queuing models.

Section-C

Heuristic modeling, Neural, Fuzzy and Neuro-Fuzzy modeling and simulation of dynamical systems. Modeling of time delays and introduction to networked dynamical systems.

Section-D

Dynamical systems imulation, Monte Carlo simulations, generation of simulation data and its statistical analysis, Statistical validation techniques, Goodness of fit test - 2 χ and others, Agent based simulation, Numerical issues in simulation of dynamical systems.

Text / References:

1. Sheldom Ross, "Simulation", Academic Press, Elsevier Imprint, 2006.
2. SankarSen Gupta. "System Simulation and Modeling", Pearson Education, 2013.
3. J. Banks, J. S. Carson, B. Nelson and D. M. Nicol, "Discrete Event system simulation", Pearson Education, 5th Edition, 2014.
4. J. R. Jang and C. Sun, "Neuro-Fuzzy Modeling and Control", Proceedings of IEEE, Vol. 83, No. 3, March 1995.

SOLAR PHOTOVOLTAIC TECHNOLOGY

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

Course Code	OEC- EE-415G		
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 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

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.

Section-D

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.

Disaster Management		
Course Code	**OEC-EE-417G**	**External Marks: 75**
Credits	**3**	**Internal Marks: 25**
L-T-P	**3-0-0**	**Total Marks: 100**
		Duration of Examination: 3h

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

Definition of Disaster, hazard, 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

Meaning and 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.Forest Related disasters, Mining disasters, Atmospheric disasters.

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.Use of Internet and software for effective disaster management.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

- Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
- Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
- Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011

Micro Electro Mechanical Systems

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

Course Code	OEC-EE-419G		
Category	Open Elective Course		
Course title	Micro Electro Mechanical Systems (Theory)		
Scheme	**L**	**T**	**P**
	3	0	**-**

Course Objectives:

1. To understand the principle and operation MEMS
2. To realize the scope and application of MEMS
3. To be aware of the process of development of MEMS and factor affecting their operation.

Course Outcomes:

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

1. Recognize the basic operation and working of MEMS

2. Identify new applications and directions of MEMS
3. Describe the techniques for building micro-devices.
4. Critically analyze micro-systems for technical feasibility as well as practicality.

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 fromeach unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.

Section-A

Introduction to Microsystems: An introduction to Micro Sensors and MEMS, Evolution of Micro Sensors and MEMS, MEMS Materials. Laws of Scaling, Multi disciplinary nature of MEMS, Application of MEMS

Section-B

Micro Sensors and Actuators: Working principle of Microsystems, Micro Actuation techniques, Micro Sensors: Types, Micro Actuators: Types, Micro pump, Micro Motors, Micro Accelerometers.

Section-C

Fabrication Process & Micro System Manufacturing: Bulk Micro Manufacturing, Surface Micro manufacturing, LIGA, SLIGA.

Section-D

Packaging & Reliability Issues: Micro System Packaging Materials, Packaging Techniques, Assembly of Microsystems, Reliability of MEMS.

Text / References

1. Jan G. Korvink, Oliver Paul, "MEMS: A Practical Guide to Design, Analysis and Applications", Wiliam Andrew Publishing, Springer.
2. Danny Banks, "Micro Engineering, MEMS, and Interfacing", Taylor & Francis.
3. Tai-Ran-Hsu, "MEMS and Microsystems",

ADVANCED MICROPROCESSORS

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

Course Code	**OEC-EE-421G**		
Category	**Open Elective Course**		
Course title	**ADVANCED MICROPROCESSORS**		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

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 end of the course, students will be able to:

1. Describe the general architecture of a microcomputer system and architecture & organization of 8086 Microprocessor.
2. Understand and realize the Interfacing of memory & various I/O devices with 8086 microprocessors.
3. Understand and classify the instruction set of 8086 microprocessor and distinguish the use of different instructions and apply it in assembly language programming.
4. Explain the historic evaluation of 80286,386,486

Section A

INTEL'S X86 FAMILY :Introduction, Register set, data formats, addressing modes, interrupts, memory hierarchy, pipelining, segmentation, paging, real and virtual mode execution, protection mechanism, task management.

Section B

ARCHITECTURE OF INTEL X86 FAMILY : CPU block diagrams, Pin diagrams and internal descriptions of - 80286,386,486 and Pentium. Instruction formats. Intel X86 Instruction set. Assembler directives.

Section C

ARITHMETIC CO-PROCESSORS : Data formats; 80287 architecture – Pin diagram, internal architecture, status register, control register; tag register. Instruction set – data transfer, arithmetic, omparison, transcendental operations, constant operations and control instructions. Interfacing 80287 with 80286 Programming examples.

Section D

HIGHER- CO-PROCESSORS :Introduction to 80387,80487.

Text/Reference Books:

1. Daniel Tabak, Advanced Microprocessors (2nd ed) McGraw Hill Pub.
2. Barry B.Brey, The Intel Microprocessors (4th ed) PHI Pub.
3. DV-Hall , Microprocessors & Interfacing (2nd ed) McGraw Hill Pub.

Industrial Automation

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

Course Code	**OEC-EE-423G**		
Category	**Open Elective Course**		
Course title	**Industrial Automation**		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

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 Outcome:

After learning the course the students will be able to:

1. Understand various automation components and systems
2. Draw block diagram of industrial automation and control system
3. Explain architecture of industrial automation system

4. Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.
5. List basic devices used in automated systems
6. Use programmable logic controllers for industrial automation
7. Draw block diagram of supervisory control and data acquisition (SCADA).
8. Integrate SCADA with PLC systems
9. Use Internet of Things for industrial automation
10. Know use of robot for industrial applications

Section A

Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA).Industrial bus systems: modbus& profibus

Section B

Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives for motion control.

Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, Industrial communication systems, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

Section C

Programmable logic controllers: Programmable controllers,Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

Section D

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Text/Reference Books:

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
3. Industrial control handbook, Parr, Newnem
4. Programmable logic controller, Dunning, Delmar

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**	**Semester-VII**
	3	0	0	3	
Objectives:	Students will be able to understand: 1. Evolution ofManagement and contribution of Management thinkers. 2. The importance of staffing and training 3. The concept ofmaterial management and inventory control 4. Thecomponents of marketing and advertising 5. Various sourcesof 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 McGraw Hill)

REFERENCES:

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)
2. Management – Harold, Koontz and Cyrilo Donell (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 L	T	P	Examination Schedule (Marks) Mark of Class work	Theory	Practical	Total	Credit	Duration of Exam (Hours)
1.	Refer to Table-III	Program Elective –VI	3	1	0	25	75	0	100	4	3
2.	Refer to Table-IV	Open Elective-V	3	0	0	25	75	0	100	3	3
3.	Refer to Table-IV	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-3
PROGRAM ELECTIVE LIST FOR VIII SEM

S. No.	Course Code	Title of the Course
1.	PEC-EE-402G	Special Electrical Machines
2.	PEC-EE-404G	Electrical Safety and Standards
3.	PEC-EE-406G	Energy Management and Auditing
4.	PEC-EE-408G	Advanced Control Systems
5.	PEC-EE-410G	Advances in Power Transmission & Distribution
6.	PEC-EE-412G	Power System Stability
7.	PEC-EE-414G	Applications of Power Electronics in Power Systems
8.	PEC-EE-416G	**Image Processing**
9.	PEC-EE-418G	**Artificial Intelligence and Expert system**
10	PEC-EE-420G	**Software Engineering**

TABLE-IV
OPEN ELECTIVE LIST FOR VIII SEM

S. No.	Course Code	Title of the Course
1	OEC-EE-402G	Optimization Theory
2	OEC-EE-404G	Virtual Instrumentation
3	OEC-EE-406G	Solar Thermal Applications
4	OEC-EE-408G	Renewable Energy Converters
5	OEC-EE-410G	Intelligent Instrumentation
6	OEC-EE-412G	Solid & Hazardous waste management
7	OEC-EE-414G	Robotics
8	OEC-EE-416G	Industrial control
9	OEC-EE-418G	Solar Energy Appliances
10	OEC-EEE-420G	OP-Amp Application

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 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.

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 ,AshfaqHussain, DhanpatRai
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.

Electrical Safety and Standards

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

Course Code	PEC-EE-404G		
Category	Program Elective Course		
Course title	Electrical Safety and Standards (Theory)		
Scheme	**L**	**T**	**P**
	3	1	**-**

Course Objectives:

1. Understand

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 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

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... ,regulatorybodiesnational 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.

Energy Management and Auditing

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

Course Code	PEC-EE-406G		
Category	PROGRAM ELECTIVE COURSE		
Course title	**Energy Management and Auditing**		
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:

- 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.

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.

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

Course Objectives:

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

Course Outcomes:

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

SECTION-A

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

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Text / Reference Books:

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&WeipingLi, 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 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

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.

Power System Stability

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

Course Code	PEC- EE-412G		
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 StabikityProblem : 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

Applications of Power Electronics in Power Systems

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

Course Code	PEC-EE-414G		
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.

IMAGE PROCESSING

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

Course Code	**PEC-EEE-416G**
Category	**Program Elective Course**
Course title	**IMAGE PROCESSING**

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:

After learning the course the students shall be able to:

1. Understand the need for image transforms different types of image transforms and their properties.
2. Develop any image processing application.
3. Understand the rapid advances in Machine vision.
4. Learn different techniques employed for the enhancement of images.
5. Learn different causes for image degradation and overview of image restoration techniques.
6. Understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
7. Learn different feature extraction techniques for image analysis and recognition

Section A

INTRODUCTION: Image Processing Fourier Transform and Z-Transform Causality and stability Toeplit and Circulate Metrics orthogonal and unitary Matrices and Kronecker product, Markov Processes KI Transform Mean square Estimates and Orthogonal Principles.

IMAGE SAMPLING QUANTIZATION : Band Limited Image Sampling Versus Replication, Reconstruction of Image from samples Sampling Theorem, Sampling Theorem for Random Fields, Optimal Sampling, Nonrectangular Grid Sampling, Sampling Aperture, Display Aperture/ Interpolation Functions, Lagrange Interpolation Moire Effect. Image Quantization Uniform Optimal Quantizer, Properties of Mean Square Quantizer, Commander Design Visual Quantization

Section B

IMAGE TRANSFORMS: Two Dimensional Orthogonal and Unitary Transforms and their properties. One Dimensional and Two Dimensional DFT Cosine and Sine Transforms.Hadamard, Slant, Harr and KL, Transforms and their properties, Approximation to KI Transforms.

IMAGE REPRESENTATION BY STOCHASTIC MODELS: One Dimensional Causal Models, AR and ARMA models, Non Causal Representation Spectral factorization, Image Decomposition.

Section C

IMAGE ENHANCEMENT AND RESTORATION: Point Operation, Histogram Modeling, Spatial Operations, Transform Operations, Multispectral Image Enhancement. Image Observation Models, Inverse and Wiener filtering; FIR Wiener Filters, Filtering using Image Transform Causal Models and recursive filtering Maximum entropy restoration. Extrapolation of band limited signal.

Section D

IMAGE ANALYSIS AND IMAGE COMPRESSION: Spatial feature extraction, Edge detection and boundary extraction Boundary, region and moment representations structures, Texture, Image Segmentation, Reconstruction from Projections, Pixel Coding, Productive Techniques, Transform Coding Theory, Coding of Image, Coding of two-tone image.

Text/Reference Books:

1. Anil Jain, Digital Image Processing , PHI.
2. Gonzalez and Woods, Image Processing, Addison Wesley & Sons.

ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

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

Course Code	**PEC-EEE-418G**		
Category	**Program Elective Course**		
Course title	**ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS**		
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:

Upon successful completion of this course, the students shall be able to:

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Demonstrate profciency developing applications in an 'AI language', expert system shell, or data mining tool.
5. Demonstrate profciency in applying scientifc method to models of machine learning.
6. Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications

Section A

Introduction: - Definition of AI, evolution of Computing, History of AI, Classical, Romantic and Modern period, subject area, Architecture of AI machines, logic family, conclusion.

Production System: - Production rules, the working memory, Recognize-act cycle, conflict resolution strategies, refractoriness, Regency, specificity, alternative approach for conflict resolution, Architecture of production system, conclusion.

Section B

Prepositional Logic: - Proposition, tautologies, Theorem proving in prepositional logic, Semantic method of theorem proving, forward chaining, backward chaining, standard theorems in prepositional logic, method of substitution, theorem proving using Wang's algorithm, conclusion.

Predicate Logic: - Alphabet of First order logic (FOL), predicate, well formed formula, clause form, algorithm for writing sentence into clause form, inflict of predicates, unification algorithm, resolution Robinson's inference rule, conclusion.

Section C

Logic Programming and Prolog: - Logic program, Horn clause, program for scene interpretation, unification of goals, definite perform clause, SLD resolution, SLD tree, controlling back tracking, common use of cut, implementation of backtracking using stack, risk of using cuts, fail predicate, application of cut-fail combination, replace cut-fail by not, conclusion.

Default & Non monotonic reasoning: - Axiomatic theory, non-atomic reasoning using NML-I, problems with NML-I, reasoning with NML-II, truth maintenance system with example, conclusion.

Section D

Imprecision & Uncertainty: - Definition, Probabilistic technicians, Fuzzy reasoning, certainty factor based reasoning conditional probability, Baye's Theorem and its limitations, Bayesian belief network, propagation of belief, Dempster-Shafer theory of uncertainty management, belief interval, Fuzzy ration, inverse Fuzzy relations, Fuzzy post inverse, Fuzzy Inversion scope of neural network, EX-OR classifier, clustering by neural network, function approximation by neural net, retrieval of content, Fuzzy association memory, cognitive reasoning using fuzzy neural net, Hebbian learning, stability analysis.

Intelligent Search Technique: - Heuristic function, AND-OR graph, Heuristic search, A* algorithm and examples.

Text/Reference Books:

1. E.Charniak& D. McDermott , Introduction to Artificial Intelligence , Addison Wesley Longman.

SOFTWARE ENGINEERING

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

Course Code	**PEC-EEE-420G**		
Category	**Program Elective Course**		
Course title	**SOFTWARE ENGINEERING**		
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:

Upon successful completion of this course, the students shall be able to:

1. Students will be able to decompose the given project in various phases of a lifecycle.
2. Students will be able to choose appropriate process model depending on the user requirements.
3. Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Students will be able to know various processes used in all the phases of the product.
5. Students can apply the knowledge, techniques, and skills in the development of a software product

Section A

Introduction: Introduction to Software crisis & Software processes; Software life cycle models – Build & Fix, waterfall prototype evolutionary, spiral model.

Requirement Analysis & Specifications: Problem Analysis – DFD, Data dictionaries, ER diagrams, object diagrams; approaches to problems analysis; SRS; specifying behavioral & non-behavioral requirements.

Section B

Software Design: What is design? Modularity, strategy of design, function oriented design, object oriented design.

Software Metrics: Introduction, size metrics, data structure metrics, information flow metrics, entropy-based measures, metric analysis.

Section C

Software Reliability: Importance, Software reliability & Hardware reliability, failures & faults, reliability concepts, reliability models – macro, basic, logarithmic Poisson, calendar time component, micro models; estimating number of residual errors; reliability allocation.

Section D

Software Testing: Introduction, Functional testing, structural testing, activities during testing, debugging, testing tools.

Software Maintenance: Introduction, types of maintenance, maintenance process, maintenance models, reverse engineering, re-engineering.

Text/Reference Books:

1. R.S. Pressman, Software Engineering – A Practitioner's Approach, 5th Ed, TMH, 2000.
2. Ian Sommerville, Software Engineering, 4th Ed., Addison Wesley.
3. PankajJalote, An Integrated Approach to Software Engineering 2nd Ed, Narosa Publishing.

Optimization Theory

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

Course Code	OEC- EE-402G		
Category	Open Elective Course		
Course title	Optimization Theory (Theory)		
Scheme	**L**	**T**	**P**
	3	-	-

Course Objectives:

1. To Create an Engineering design methodology using a mathematical formulation of a design problem to support selection of the optimal design among alternatives

Course Outcomes:

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

1. Ability to apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems

2. Ability to go in research by applying optimization techniques in problems of Engineering and Technology

3. Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software

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 to Optimization:
Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima – Optimality criteria - Review of basic calculus concepts – Global optimality.

Section-B

Linear programming methods for optimum design:
Review of Linear programming methods for optimum design – Post optimality analysis - Application of LPP models in design and manufacturing.
Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method.

Section-C

Optimization:
Optimization algorithms for solving constrained optimization problems – direct methods – penalty function methods – steepest descent method - Engineering applications of constrained and unconstrained algorithms.

Section-D.

Modern methods of Optimization:
Genetic Algorithms - Simulated Annealing - Ant colony optimization - Tabu search – Neural-Network based Optimization – Fuzzy optimization techniques – Applications. Use of Matlab to solve optimization problems.

Text / References

1. Rao S. S. - 'Engineering Optimization, Theory and Practice' - New Age International Publishers – 2012 - 4th Edition
2. Deb K. - 'Optimization for Engineering Design Algorithms and Examples' – PHI - 2000

3. Arora J. - 'Introduction to Optimization Design' - Elsevier Academic Press, New Delhi - 2004

Solar Thermal Applications

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

Course Code	OEC- EE-406G
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 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

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

VIRTUAL INSTRUMENTATION

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

Course Code	OEC- EE-404G		
Category	Open Elective Course		
Course title	Virtual Instrumentation (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

Course Objectives:

1. Understand

    1. Familiarize with the VI software and learn programming in VI.
    2. Acquire knowledge on Data Acquisition Systems and network interface concepts.
    3. Understand various analysis tools and develop programs for Industrial Applications

Course Outcomes:

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

1. Understand Virtual Instrument concepts.
2. Create a Virtual Instrument using graphical programming
3. Develop systems for real-time signal acquisition and analysis.
4. Apply concepts of network interface for data communication.
5. Implement and design data acquisition systems for practical applications.
6. Suggest solutions for automation and control applications using virtual instrumentation.

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

Review Of Virtual Instrumentation:

Historical perspective, advantages, Block diagram and Architecture of a Virtual Instrument, Data Flow Techniques, Graphical programming in data flow, comparison with Conventional programming.

Section-B

Programming Techniques:

Loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O. Signals Handling and Classification – Signal Conditioning - Analog Interfacing (I/O) - Counters & Timers – Digital (I/O) - DAQ Hardware – DAQ Software Architecture - DAQ Assist.

Section-C

Common Instrument Interfaces:

GPIB-RS232-Handshaking- RS232/RS485 interfacing, VISA – IVI - PCMCIA – SCXI – VXI - Networking basics for office & Industrial applications

Section-D

Applications:
Motion Control - Virtual Instrumentation and CAD Tool, Remote Front Panel LabVIEW Applications, Timed Loop Applications Client–Server Applications – Case Studies

Text / References
1. Dr. Sumathi. S and Prof. Surekha. P, "LabVIEW Based Advanced Instrumentation Systems", 2nd edition, 2007.
2. Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Pvt. Ltd, New Delhi, 2010.
3. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill, 2006.
4. Lisa .K, Wells and Jeffrey Travis, "LABVIEW for Everyone", Prentice Hall, 2009.

Renewable Energy Converters

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

Course Code	OEC-EE-408G		
Category	Open Elective Course		
Course title	Renewable Energy Converters (Theory)		
Scheme	**L**	**T**	**P**
	3	0	**-**

Course Objectives:
2. Understand

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 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 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.

Intelligent Instrumentation

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

Course Code	OEC- EE-410G		
Category	Open Elective Course		
Course title	Intelligent Instrumentation (Theory)		
Scheme	**L**	**T**	**P**
	3	-	-

Course Objectives:

1. Understand

1 This course introduces basic concept of intelligent sensor, Data acquisition, application of automation in industrial application.
2 It also helps to understand the student the application of intelligent controller in instrument.

Course Outcomes:

At the end of this course, students will demonstrate the ability to
1 Able to understand the basic characteristic of intelligent instrumentation system
2 Knowledge of new sensor technology
3 Able to understand the data acquisition system in intelligent instrumentation system
4 Knowledge of automation in industrial plant
5 Able to understand the intelligent controller used in intelligent instrumentation system

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one willhave 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

Introduction: Intelligence, features characterizing intelligence, intelligent instrumentation system; features of intelligent instrumentation; components of intelligent instrumentation system. Block diagram of an intelligent instrumentation system.

Smart Sensors : Primary sensors; Excitation; Compensation (Nonlinearity: look up table method, polygon interpolation, polynomial interpolation, cubic spline interpolation, Approximation & regression: Noise & interference; Response time: Drift; Cross-sensitivity); information coding/Processing; Data Communication; Standards for smart sensor interface. Recent Trends In Sensor Technologies: Introduction; Film sensors (Thick film sensors, this film sensor) Semiconductor IC Technology- Standard methods; Micro electro-mechanical systems (Micro-machining, some application examples); Nono-Sensors.

Section-B

Interfacing Instruments &Computers : Instrumentation systems, Types of Instrumentation systems, Data acquisition system and its uses in intelligent Instrumentation system, Detailed study of each block involved in making of DAS, Signal Conditioners: as DA, IA, Signal Converters (ADC & DAC), Sample and hold, Designing of Pressure, Temperature measuring instrumentation system using DAS, Datalogger

Section-C

Automatic Process Control : Automation system, Concepts of Control Schemes, Types of Controllers, Components involved in implementation of Automation system; Converter (I to P) and Actuators: Pneumatic cylinder, Relay, Solenoid (Final Control Element), Computer Supervisory Control System (SCADA), Direct Digital Control's Structure and Software Introduction of Programmable logic controller, Principles of operation, Architecture of Programmable controllers, Programming the Programmable controller, Industrial control applications like cement plant, thermal power plant.

Section-D.

Intelligent controllers : Introduction about Intelligent controllers, Model based controllers, Predictive control, Artificial Intelligent Based Systems, Experts Controller, Fuzzy Logic System and Controller, Artificial Neural Networks, NeuroFuzzy Controller system.

Text / References

1. G. C. Barney, "Intelligent Instrumentation", Prentice Hall, 1995.
2. Computer-Based Industrial Control", by Krishna Kant, PHI.
3. Process Control Instrumentation Technology", by Curtis D Johnson, Pearson Ed.
4. Electrical and Electronics Measurement and Instrumentation" by A. K. Swahney.
5. Electronics instrumentation" by H. S. Kalsi [TMH]
6. ALAN S. Morris, Principles of Measurement s Instrumentation. New. Delhi: PHI Pvt. Ltd. 1999.
7. D.Patranabis, Sensors s Transducers. New .Delhi: PHI, 2003.
8. Roman Kuc, Introduction to Digital Signal Processing. New York: McGraw-Hill Pub. Co.

Solid & Hazardous waste management		
Course Code	**OEC –EE-412G**	**External Marks: 75**
Credits	**3**	**Internal Marks:25**
L-T-P	**3-0-0**	**Total Marks: 100**
		Duration of Examination: 3h

COURSE OBJECTIVES:

- To understand the sources of solid and hazardous wastes.
- To understand methods of solid and hazardous waste disposal.
- To gain knowledge of E-Waste management.

Note: Examiner will set 9 questions in total, with two questions from each section and one question covering all the section which will be Q. 1. Question number 1 will be compulsory and of short answer type. Each question carries equal marks (15 marks). Students have to attempt five questions in total by selecting one question from each section

Section A

Sources and Composition of Municipal Solid Waste

Introduction, Sources and Types of solid waste, Composition of Solid Waste and its Determination, Properties of Municipal Solid Waste

Solid Waste Generation and Collection

Quantities of Solid Waste, Measurements and methods to measure solid waste quantities, Solid waste generation and collection, Factors affecting solid waste generation rate, Quantities of materials recovered from MSW.

Section B

Handling, Separation and Processing of Solid Waste

Handling and separation of solid waste at site- Material separation by pick in, screens, float and separator magnets and electromechanical separator and other latest devices; Waste handling and separation at Commercial and industrial facilities, Processing of solid waste at residence, Commercial and industrial site - Storage, conveying, compacting, Shredding, pulping, granulating etc.

Disposal of Municipal Solid Waste

Landfill: Classification, planning, sitting, permitting, landfill processes, landfill design, landfill operation, use of old landfill; Combustion and energy recovery of municipal solid waste, effects of combustion, undesirable effects of Combustion

Section C

Hazardous Waste Management

Definition, identification and classification of hazardous solid waste. The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment.

Biological Treatment of Solid and Hazardous Waste

Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

Section D

Radioactive Waste Management

Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

Electronic waste management

E waste- Definition, composition; environmental and human health issues, recovery of metals from E waste, E waste management,

COURSE OUTCOMES:

After completing this course, students should be able:

- To realize the significance of solid and hazardous waste management in today life
- To understand the processes involved in solid and hazardous waste management
- To comprehend the techniques for various waste management
- To appreciate the role of common/integrated waste management plants

Suggested Books:

1. Basics of Solid and Hazardous Waste Mgmt. Tech. by KantiL.Shah 1999, Prentice Hall.
2. Solid And Hazardous Waste Management 2007 by S.C.Bhatia Atlantic Publishers & Dist.
3. John Pichtel Waste Management Practices CRC Press, Taylor and Francis Group 2005.

Robotics

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

Course Code	OEC-EE-414G		
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.

Industrial Control

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

Course Code	OEC-EE-416G		
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.

SOLAR ENERGY APPLIANCES

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

Course Code	OEC- EE-418G
Category	Open Elective Course

Course title	SOLAR ENERGY APPLIANCES (Theory)		
Scheme	**L**	**T**	**P**
	3	-	-

Course Objectives:

1To 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

3. The fundamental concepts about solar energy systems and devices are incorporated.
4. 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 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

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,Van Nostrand Reinhold Co., 2007.
7. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008

OP-AMP APPLICATIONS

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

Course Code	**OEC-EEE-420G**
Category	**Open Elective Course**
Course title	**OP-AMP APPLICATIONS**

Scheme	L	T	P
	03	-	-

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 Outcome:

Upon successful completion of this course, students will be able to:

1. Describe operational amplifiers (op-amps) fundamentals and their applications.
2. Analyze and design of op-amp based feedback circuits with various inverting and non-inverting configurations.
3. Design linear op-amp circuits, including amplifiers, I-V/V-I converters, instrumentation amplifiers, integrators, differentiators.
4. Demonstrate basic filter theory, filter responses, and filter synthesis techniques.
5. Analyze and design of discrete-time circuits (switched capacitor circuits) based on op amps.
6. Analyze and design of nonlinear circuits (e.g., comparators, Schmitt triggers, rectifiers, and peak detectors) based on op amps.

Section A

The operational amplifier, block diagram representation of an op amp, the ideal op-amp, equivalent circuit of an op- amp, ideal voltage transfer curve, frequency response , characteristic parameters , op-amp configurations.

Section B

Op-amp with feedback ,inverting and non-inverting amplifiers, effects of feedback..

Section C

Op-amp applications: summing, scaling, ,averaging amplifiers,instrumentation amplifier, voltage to current converter with floating load, voltage to current converter with grounde load, current to voltage converter, very high input impedance circuit,theintregrator, the differentiator, ,peak detector,sample and hold circuit.

Section D

Non-linear applications: basic comparator,zero-crossing detector,scmitt trigger, clippers and clampers,Multivibrators,

Text/Reference Books:

1. Ramakant A. Gayakwad.,Op-amp and linear integrated circuits ,PHI

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 (25 Marks)

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