MAHARSHI DAYANAND UNIVERSITY, ROHTAK
ELETRICAL ENGINEERING
B. Tech, 2nd year (IIIrd semester) w.e.f 2019-20

S. No.	Course Code	Course Title	Teaching Schedule			Marks of Class Work	Examination Marks		Total Marks	Credits	Duration of Examination (in hours)
			L	T	P		Theory	Practical			
1.	PCC-EE-201G	Electric Circuit Analysis	3	1	0	25	75	0	100	4	3
2.	PCC-EE-203G	Electric Circuit Analysis Laboratory	0	0	2	25	0	25	50	1	-
3.	PCC-EE-205G	Analog Electronics	3	0	0	25	75	0	100	3	3
4.	PCC-EE-207G	Analog Electronics Laboratory	\ 0	0	2	25	0	25	50	1	-
5.	PCC-EE-209G	Electrical Machines-I	3	1	0	25	75	0	100	4	3
6.	PCC-EE-211G	Electrical Machines-I Laboratory	0	0	2	25	0	25	50	1	-
7.	PCC-EE-210G	Measurement and Instrumentation	3	0	0	25	75	0	100	3	3
8.	PCC-EE-212G	Measurement and Instrumentation Laboratory	0	0	2	25	0	25	50	1	-
9.	ESC-202-G	Engineering Mechanics	3	1	0	25	75	0	100	4	3
10.	MC-GES-106-G	Environmental Studies	3	0	1	25	75	0	100	0	3
Total									800	22	

L-Lecture, T-Tutorial, P-Practical

Note: The use of programmable devices such as programmable calculators etc. is not allowed during the exam. Sharing of materials will not be permitted during examination.

Electric Circuit Analysis

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

Course Code	**PCC-EE-201G**		
Category	**Engineering Science Course**		
Course title	**Electric Circuit Analysis**		
Scheme	**L**	**T**	**P**
	3	**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;

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyze two port circuit behavior.

SECTION-A

Network Theorems (AC Circuit)

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

SECTION-B

Solution of First and Second order networks (AC and DC circuits)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

SECTION-C

Sinusoidal steady state analysis

Hurwitz polynomials, positive real functions. Properties of real immittance functions, Synthesis of LC driving point immittances, Synthesis of RC driving point impedances, Synthesis of RC impedances or RL admittances, properties of RL impedances and RC admittances. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits.

SECTION-D

Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros.

Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks. Synthesis of Y21 and Z21 with R ohm terminations Network Tropology and Graph Theory.

Text / Reference Books:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 1999.

Electric Circuit Analysis Laboratory

Class Work:	25
Exam :	25
Total :	50

Course Code	**PCC-EE-203G**		
Category	**Engineering Science Course**		
Course title	**Electric Circuit Analysis** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. Introduction of circuit creation & simulation software like MATLAB etc.
2. Study of Transient response of RC, RL circuit.
3. To find the resonance frequency, Band width of RLC series circuit.
4. To calculate and verify "Z" & "Y" parameters and "ABCD" parameters of a two port network.
5. To determine equivalent parameter of parallel-series, cascading and parallel connections of two port network.
6. To calculate and verify Compensation theorem and Tellegen's theorem.
7. To synthesize a network of a given network function and verify its response.
8. To calculate and verify Maximum power transfer and Reciprocity theorem.

Note: Use appropriate Software or simulation tool for experiments.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Analog Electronics

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

Course Code	**PCC-EE-205G**		
Category	**Engineering Science Course**		
Course title	Analog Electronics (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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 characteristics of transistors.
- Design and analyse various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Section-A

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits. Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Section-B

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Section-C

Operational Amplifier: Inverting and non-inverting configurations, difference amplifier, Effect of finite open loop gain and bandwidth on circuit performance, Large signal operation of op-amp. Differential Amplifier: MOS differential pair, small signal operation of the MOS differential pair, BJT differential pair, other non-ideal characteristic of the Differential amplifier (DA), DA with active load
Feedback: The general feed back structure, properties of negative feed back, the four basic feed back topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, the shunt-shunt and shunt series feedback amplifier.

Section-D

Linear applications of op-amp: Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.
Nonlinear applications of op-amp: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References Book:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

Analog Electronics Laboratory

Class Work:	25
Exam :	25
Total :	50

Course Code	**PCC-EE-207G**		
Category	**Engineering Science Course**		
Course title	**Analog Electronics** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(iii) Gruoup of students for practical should be 15 to 20 in number.

List of Experiments

1.To Study the following devices: (a) Analog & digital multimeters (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study of analog CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
2.To Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse Saturation current and static & dynamic resistances.
3.To Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
4. To Plot frequency response curve for single stage amplifier and to determine gain bandwidth product.
5.To Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of Idss & Vp
6.To Plot gain- frequency characteristic of emitter follower & find out its input and output resistances.
7.To Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.
8.To Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripple factor.
10.To Study bridge rectifier and measure the effect of filter network on D.C. voltage output & ripple Factor.
11. To plot the characteristics of MOSFET.
12. To determine the following parameters of OP-AMP.a) Input Bias Current. b) Input Offset Current.
c) Input Offset Voltage. d) CMRR

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Electrical Machine-I

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

Course Code	**PCC-EE-209G**		
Category	**Engineering Science Course**		
Course title	**Electrical Machine- I** (Theory)		
Scheme	**L**	**T**	**P**

	3	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 concepts of magnetic circuits.
- Understand the operation of dc machines.
- Analyse the differences in operation of different dc machine configurations.
- Analyse single phase and three phase transformers circuits.

Section A

Magnetic fields and magnetic circuits

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Electromagnetic force and torque

B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

Section B

DC machines

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Section C

DC machine - motoring and generation

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed.V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Section D

Transformers

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text / Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Electrical Machines-I Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	**PCC-EE-211G**		
Category	**Engineering Science Course**		
Course title	**Electrical Machines-I** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Gruoup of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. To study conversion of 3 Phase to six phase using 3 single phase transformers..
2. To study three phase rectifiers & supply configuration . In 3 phase.
3. To perform Sumpner's Back to back test on 1-phase transformers.
4. To study Parallel operation of two 1-phase transformers.
5. To perform load test on DC shunt generator.
6. To study Speed control of DC shunt motor.
7. To study Swinburne's test of DC shunt motor.
8. To study Hopkinson's test of DC shunt M/Cs.
9. To syudy Ward Leonard method of speed control.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Engineering Mechanics

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

Course Code	**ESC-202-G**		
Category	**Engineering Science Course**		
Course title	**Engineering Mechanics** (Theory)		
Scheme	**L**	**T**	**P**
	3	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

1. Understand the concepts of co-ordinate systems.
2. Analyse the three-dimensional motion.
3. Understand the concepts of rigid bodies.
4. Analyse the free-body diagrams of different arrangements. Analyse torsional motion and bending moment.

UNIT-I

Introduction to vectors and tensors and co-ordinate systems: Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Symmetric and anti-symmetric tensors; Eigen values and Principal axes.
Three-dimensional Rotation: Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

UNIT-II

Kinematics of Rigid Body: Concept of rigid body, velocity and acceleration, relative velocity, translation and rotation of rigid bodies, equations of motion for translation and rotation, problem. Centroid, Centre of mass and Centre of gravity, Determination of centroid, centre of mass and centre of gravity by integration method of regular and composite figures and solid objects, Problems.

Kinetics of Rigid Bodies: Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

UNIT-III

Free Body Diagram: Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.
General Motion: Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

UNIT-IV

Bending Moment: Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.
Torsional Motion: Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.
Friction: Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:

1. Mechanics by R.C. Hibbler, Pearson Publication
2. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
3. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

MEASUREMENT AND INSTRUMENTATION

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

Course Code	**PCC-EE-210G**

Category	**Engineering Science Course**		
Course title	Measurement and Instrumentation (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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;

- Learn about various measurement instruments for measurement of Voltage, Current, Power, Power Factor & Frequency, their construction, operating principle, limitations, etc.;
- Understand the working of energymeters and wattmeters;
- Analyse the static characteristics of instruments
- Understand the measurement of parameters & variables with the help of D.C. & A.C. bridges

Section A

UNITS STANDARDS & ERRORS: S.I. units, Absolute standards (International, Primary, Secondary & Working Standards), True Value, Errors (Gross, Systematic, Random); Static Characteristic of Instruments (Accuracy, Precision, Sensitivity, Resolution & threshold). Generalized Instrument (Block diagram), three forces in Electromechanical indicating instrument, Comparison between gravity & spring controls; Comparison of damping methods & their suitability, bearing supports, pivot-less supports (Simple & taut-band), Scale information, Instrument cases.

Electronic Devices: Block diagram and study of various stages of CRO, Block diagram and working of function generator.

Transducers : Classification and types: R, L, C. Basic schemes for the measurement of displacement, velocity, strain, pressure, liquid level & temperature.

SECTION-B

MEASURING SYSTEM FUNDAMENTALS: Classification of Instruments (Absolute & Secondary Instruments; Indicating, Recording & Integrating instruments; Based upon Principle of operation).

MEASURING INSTRUMENTS: Study of measuring instruments of PMMC types, Electrodynamic Type, Moving iron type, Induction type as Ammeter & Voltmeter (Both on AC & DC). Hot wire type instruments, Electrostatic type Instruments. Multimeter, Q-meters.

SECTION-C

WATTMETERS & ENEGRY METERS: Construction, operating principle, Torque equation, Shape of scale, Errors, Advantages & Disadvantages of Electrodynamic & Induction type Wattmeters. Single phase induction type Energy meter, Compensation & creep in energy meter.

POWER FACTOR & FREQUENCY METERS: Construction, operation, principle, torque equation, advantages & disadvantages and errors of Single phase power factor meters (Electrody namic & Moving Iron types) & Frequency meters (Electrical Resonance Type, Ferrodynamic Type & Electrodynamic types).

SECTION-D

LOW & HIGH RESISTANCE MEASUREMENTS: Limitations of Wheatstone bridge; Kelvin's double bridge method, Difficulties in high resistance measurements, Measurement of high resistance by direct deflection, loss of charge method, Megohm bridge & Meggar.

A.C. BRIDGES: General balance equation of AC bridges. Circuit diagram, phasor diagram, advantages & disadvantages and applications of Maxwell's Inductance Bridge, Maxwell's inductance-capacitance Bridge, Hays Bridge, Anderson Bridge, Owens Bridge, De-Sauty's Bridge, Schering & Weins bridges, Shielding & earthing.

TEXT BOOK:

1. A course in Electrical & Electronics Measurements & Instrumentation: A.K.Sawhney; Dhanpat Rai
2. Measurements & Instrumentation by J.S. Saini; New Age Pub., N. Delhi

3. Morris - Electronic Measurements & Instrumentation, Elsevier

REFERENCE BOOKS:

1. Electrical Measurments by E.W. Golding
2. Electronic & Elect. Measurment & Instrumention by J.B.Gupta; Kataria & Sons.
3. Electronic Instrumentation & Measurment Technique, W.D.Cooper & A.D. Helfrick.
4. Measuring Systems by E.O. Doeblin; TMH.

Measurement and Instrumentation Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	**PCC-EE-212G**		
Category	**Engineering Science Course**		
Course title	**Measurement and Instrumentation** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS

1. To Study construction of different types of meters & study how to connect them in a circuit..
2. To calibrate a voltmeter & an ammeter using a potentiometer.
3. To study the working of a electronic energy meter (LCD/Digital display type).
4. To measure power & p.f. by 3-ammeter & 3 Voltmeter methods.
5. To study star to delta & delta to star in a Three phase system for balanced & unbalanced load.
6. To measure power & p.f in 3-phase circuit by 2-wattmeter method.
7. To measure capacitance by De Sauty's bridge.

8. To measure inductance by Maxwell’s bridge.
9. To measure frequency by Wien's bridge.
10. Determination of unknown inductance & Q factor by Hays Bridge.
11. To Measure resistance using Wheatstone bridge /Post office box.
12. To measure low resistance by Kelvin's double bridge. 14. To measure high resistance by loss of charge/Leakage method.
13. Study blocks wise construction of an analog oscilloscope & Function generator.
14. Determine output characteristics of a LVDT and Measure displacement using LVDT
15. Study characteristics of temperature transducer like Thermocouple, Thermistor &
RTD with implementation of a small project using signal conditioning circuits like instrumentation amplifier.
16. Measurement of Strain using Strain Guage.
17. To study differential pressure transducer & signal conditioning of output signal.
18. Measurement of liquid level using capacitive transducer.
19. Study of Distance measurement using ultrasonic transducer.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

Environmental Studies

Objective: To provide the basic knowledge in Environmental Sciences to students of Engineering. It will guide the students living in a historic transitional period of burgeoning awareness of the conflict between human activities and environmental constraints to help and save the fragile and endangered planet with the natural resources already overexploited.

Course code: MC-GES-106-G

Environmental Studies (Semester 1)							
Lecture	Tutorial	Practical/Field visit	Credit	Theory	Field visit	Total	Time
3	0	1	-	75	25	100	3Hrs

MC-ENV : (ENVIRONMENTAL SCIENCE)

Objective: To provide the basic knowledge in Environmental Sciences to students of Engineering. It will guide the students living in a historic transitional period of burgeoning awareness of the conflict between human activities and environmental constraints to help and save the fragile and endangered planet with the natural resources already overexploited.

Course code: MC-GES-106-G

Environmental Studies (Semester 1)							
Lecture	Tutorial	Practical/Field visit	Credit	Theory	Field visit	Total	Time
3	0	1	-	75	25	100	3Hrs

Theory 75 Marks Field Work 25 Marks (Practical/Field visit)

Unit-1 The Multidisciplinary nature of environmental studies. Definition, scope and importance. (2 lecture)

Unit-2 Natural Resources :

Renewable and non-renewable resources : Natural resources and associated problems.

a) Forest resources : Use and over-exploitation : deforestation, case studies. Timber extraction, mining dams and their effects on forests and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes, caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Water logging, salinity, case studies.

e) Energy resources : Growing energy needs; renewable and non- renewable energy sources, use of alternate energy sources, case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

* Role of an individual in conservation of natural resources.

* Equitable use of resources for sustainable lifestyles.

(8 lectures)

Unit-3 Ecosystems :

* Producers, consumers and decomposers.

* Energy flow in the ecosystem.

* Ecological succession.

* Food chains, food webs and ecological pyramids.

* Introduction, types, characteristic features, structure and function of the following eco-system :

a. Forest ecosystem.

b. Grassland ecosystem. c. Desert ecosystem.

d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit-4 Biodiversity and its conservation

* Introduction - Definition : Genetic, Species and ecosystem diversity.

* Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.

* Biodiversity at global, National and local levels.
* India as a mega-diversity nation.
* Hot-spots of biodiversity.
* Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
* Endangered and endemic species of India.
* Conservation of biodiversity : In-situ and ex-situ conservation of biodiversity.

(8 lectures)

Unit-5 Environmental pollution :

Definition, causes, effects and control measures of :

a) Air pollution.
b) Water pollution c) Soil pollution
d) Marine pollution e) Noise pollution
f) Thermal pollution g) Nuclear hazards
* Solids waste management: causes, effects and control measures of urban and industrial wastes.
* Role of an individual in prevention of pollution.
* Pollution case studies.
* Disaster management : floods, earthquake, cyclone and landslides.

(8 lectures)

Unit-6 Social issues and the Environment:

* From unsustainable to sustainable development.
* Urban problems related to energy.
* Water conservation, rain water harvesting, watershed management.
* Resettlement and rehabilitation of people : its problems and concerns case studies.
* Environmental ethics : Issues and possible solutions.
* Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies.
* Wasteland reclamation.

* Consumerism and waste products.
* Environment Protection Act.
* Air (Prevention and Control of pollution) Act.
* Water (Prevention and Control of pollution) Act.
* Wildlife Protection Act.
* Forest Conservation Act.
* Issues involved in enforcement of environmental legislation.
* Public awareness. (7 lectures)

Unit-7 Human population and the Environment.

Population growth, variation among nations. Population explosion- Family Welfare Programme. Environment and human health.

Human Rights. Value Education. HIV/AIDS.

Woman and Child Welfare

Role of Information Technology in Environment and human health.

Case Studies. (6 lectures)

Unit-8 Field Work :

* Visit to a local area to document environmental assets - river/forest/grassland/hill/mountain.
* Visit to a local polluted site-urban/Rural/ Industrial/ Agricultural.
* Study of common plants, insects, birds.
* Study of simple ecosystems- pond, river, hill slopes, etc. (Field work equal to 10 lecture hours).

References

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Pub. Ltd. Bikaner.
2. Bharucha, Frach, The Biodiversity of India, MApin Publishing Pvt. Ltd. Ahmedabad-380013, India, E-mail : mapin@icenet.net (R).
3. Brunner R.C. 1989, Hazardous Waste Incineration, Mc. Graw Hill Inc. 480p.
4. Clark R.S., Marine pollution, Slanderson Press Oxford (TB).
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Pub. House, Mumbai 1196 p.
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment (R).
8. Gleick, H.P., 1993. Water in crisis, Pacific Institute for Studies in Dev. Environment & Security Stockholm Env. Institute, Oxford Univ. Press, 473p.
9. Hawkins R.E. Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R).
10. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge Uni. Press 1140p.
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p.
12. Mackinney, M.L. & Schoch, RM 1996, Environmental Science systems & solutions, Web enhanced edition. 639p.
13. Mhaskar A.K., Mayyer Hazardous, Tekchno-Science Publications (TB).
14. Miller T.G. Jr. Environmental Science, Wadsworth Publishing

Co. (TB).

15. Odum, E.P. 1971, Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
16. Rao M.N. & Datta, A.K. 1987 Waste Water Treatment. Oxford & TBH Publ. Co. Pvt. Ltd. 345p.
17. Sharma, B.K. 2001, Environmental Chemistry, Goal Publ. House, Meerut.
18. Survey of the Environment, The Hindu (M).
19. Townsend C., Harper J. and Michael Begon. Essentials of Ecology, Blackwell Science (TB).
20. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Comliances and Standards, Vol. I and II Enviro Media (R).
21. Tridevi R.K. and P.K. Goal, Introduction to air pollution, Techno Science Publications (TR).
22. Wagner K.D., 1998, Environmental Management, W.B. Saunders co. Philadelphia, USA 499p.
23. A text book environmental education G.V.S. Publishers by Dr. J.P. Yadav.

(M) Magazine (R) Reference (TB) Textbook

The scheme of the paper will be under :

The subject of Environmental Studies will be included as a qualifying paper in all UG Courses and the students will be required to qualify the same otherwise the final result will not be declared and degree will not be awarded.

The duration of the course will be 40 lectures. The examination will be conducted along with the semester examinations. Exam. Pattern : In case of awarding the marks, the paper will carry 100 marks. Theory : 75 marks, Practical/ Field visit : 25 marks. The structure of the question paper will be :

Part- A : Short Answer Pattern : 15 marks Part- B : Essay Type with inbuilt choice : 60 mark

Part- A : Question No. 1 is compulsory and will contain five short- answer type question of 3 marks each covering the entire syllabus.

Part-B : Eight

essay type questions (with inbuilt choice) will be set from the entire syllabus and the candidate will be required to answer any four of them. Each essay type question will be of 15 marks.

The examination of the regular students will be conducted by the concerned college/Institute. Each student will be required to score minimum 40% marks separately in theory and practical/Field visit. The marks in this qualifying paper will not be included in determining the percentage of marks obtained for the award of degree. However, these marks will be shown in the detailed marks certificate of the students.

MAHARSHI DAYANAND UNIVERSITY, ROHTAK
ELECTRICAL ENGINEERING
B. Tech, 2nd year (IVth semester) w.e.f 2019-20

S. No.	Course Code	Course Title	Teaching Schedule			Marks of Class Work	Examination Marks		Total Marks	Credits	Duration of Examination (in hours)
			L	T	P		Theory	Practical			
1.	PCC-EE-202G	Digital Electronics	3	0	0	25	75	0	100	3	3
2.	PCC-EE-204G	Digital Electronics Laboratory	0	0	2	25	0	25	50	1	-
3.	PCC-EE-206G	Electrical Machines-II	3	1	0	25	75	0	100	4	3
4.	PCC-EE-208G	Electrical Machines-II Laboratory	0	0	2	25	0	25	50	1	-
5.	PCC-EE-210G	Transmission and Distribution	3	0	0	25	75	0	100	3	3
6.	PCC-EE-212G	Transmission and Distribution Laboratory	0	0	2	25	0	25	50	1	-
7.	PCC-EE-214G	Signals and Systems	3	0	0	25	75	0	100	3	3
8.	PCC-EE-216G	Electromagnetic Fields	3	1	0	25	75	0	100	4	3
9.	BSC-MATH-204G	Mathematics-III (Probability and Statistics)	3	1	0	25	75	0	100	4	3
10.		Indian Constitution	3	0	0	25	75	0	100	0	3
11.	BSC-BIO-201G	Biology-I	2	1	0	25	75	0	100	3	3
	TOTAL								850	27	

L-Lecture, T-Tutorial, P-Practical

Mandatory Course	Course Code	Course Title
		Indian Constitution
		Essence of Indian Traditional Knowledge

Digital Electronics

Note: The use of programmable devices such as programmable calculators etc. is not allowed during the exam.
Sharing of materials will not be permitted during examination.

Theory :	75
Class Work :	25
Duration of Examination	3H

Course Code	**PCC-EE-202G**		
Category	**Engineering Science Course**		
Course title	**Digital Electronics** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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 working of logic families and logic gates.
- Design and implement Combinational and Sequential logiccircuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

SECTION-A

Fundamentals of Digital Systems and logic families:
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples ofICgates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

SECTION-B

Combinational Digital Circuits:
Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

SECTION-C

Sequential circuits and systems:
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, Master Slave J- K, T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

SECTION-D

A/D and D/A Converters:
Introduction to Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, sample and hold circuit, Introduction to analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter.

Semiconductor memories and Programmable logic devices:
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic.

Text/Reference books:
1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Digital Electronics Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	**PCC-EE-204G**		
Category	**Engineering Science Course**		
Course title	**Digital Electronics** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS

1. To study of TTL gates – AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. To design & realize a given function using K-maps and verify its performance.
3. To verify the operation of multiplexer & Demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T & D type flip flops.
6. To study FLIP-FLOP conversion.
7. To verify the operation of bi-directional shift register.
8. To design & verify the operation of 3-bit synchronous counter.
9. To design and verify the operation of synchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
10. To design and verify the operation of asynchronous UP/DOWN decade counter using J K flip-flops & drive a seven-segment display using the same.
11. To design a 4 bit shift register and verify its operation.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

ELECTRICAL MACHINES-II

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

Course Code	**PCC-EE-206G**		
Category	**Engineering Science Course**		
Course title	**Electrical Machines-II** (Theory)		
Scheme	**L**	**T**	**P**
	3	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:

1. Understand the concepts of rotating magnetic fields.
2. Understand the operation of ac machines.
3. Analyse performance characteristics of ac machines.
4. Impart knowledge on construction, principle of operation and performance of ac machine.
5. Prepare the students to have a basic knowledge about motoring, generating and braking mode of ac machines

UNIT-I

Poly-phase Induction Motor: Constructional features, Principal of operation, production of rotating magnetic field, induction motor action, torque production, testing, development of

equivalent circuit, performance characteristics, circle diagram, starting methods, double cage and deep bar motors.

UNIT-II

Poly-phase Induction Motor: Methods of speed control - stator voltage control, stator resistance control, frequency control, rotor resistance control, slip power recovery control

Induction Generator: Principle of operation, types and applications.

Single Phase Induction motors: Double revolving field theory, cross field theory, different types of single phase induction motors, circuit model of single phase induction motor.

UNIT-III

Synchronous Generator: Principle, construction of cylindrical rotor and salient pole machines,winding, EMF equation, Armature reaction, testing, model of the machine, regulation – synchronous reactance method, Potier triangle method. Output power equation, power angle curve.

UNIT-IV

Three Phase Synchronous Generators: Transient and sub-transient reactance, synchronization, parallel operation.

Synchronous Motor: Principles of synchronous motor, power angle curve, V-curve, starting, damper winding, synchronous condenser, applications.

TEXT/ REFERENCE BOOKS:

1. Principle of Electrical Machines, V K Mehta, Rohit Mehta, S Chand
2. Electric Machines ,Ashfaq Hussain, Dhanpat Rai
3. Electric Machines: I.J.Nagrath and D.P. Kothari, TMH, New Delhi.
4. Generalized theory of Electrical Machines: P.S. Bhimbra(Khanna Pub.)
5.Electric Machinery, Fitzgerald and Kingsley, MGH.

Electrical Machines-II Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	**PCC-EE-208G**		
Category	**Engineering Science Course**		
Course title	**Electrical Machines-II** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS:

1. To perform the open circuit test and block rotor test on 3 phase induction motor and draw the circle diagram.
2. To study the speed control of induction motor by rotor resistance control.
3. To conduct the load test to determine the performance characteristics of the I.M.
4. To compute the torque v/s speed characteristics for various stator voltages.
5. To perform the open circuit test and block rotor test on single-phase induction motor and determine equivalent circuit parameters.
6. To perform O.C. test on synchronous generator and determine the full load regulation of a three phase synchronous generator by synchronous impedance method.
7. To Study and Measure Synchronous Impedance and Short circuit ratio of Synchronous Generator .
8. Study of Power (Load) sharing between two Three Phase alternators in parallel operation Condition.

9. To plot V- Curve of synchronous motor.
10. Synchronization of two Three Phase Alternators by
a) Synchroscope Method
b) Three dark lamp Method
c) Two bright one dark lamp Method
11. Determination of sequence impedances of synchronous machine for various stator voltages.

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups be strictly discouraged/disallowed.

TRANSMISSION AND DISTRIBUTION

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

Course Code	PCC- EE-210G		
Category	**Engineering Science Course**		
Course title	Transmission and distribution (Theory)		
Scheme	**L**	**T**	**P**
	3		**-**

Course Outcomes:
At the end of the course, students will demonstrate the ability to:
1. Understand the basic laws of Transmission and Distribution
2. Knowledge about the Structure and present-Day Scenario of a power system.
3. Analyses of transmission and distribution line parameters.
4. Understand mechanical design of transmission line with skin effect and proximity effect.
5. Understand the various cables and insulators gradings as well as ratings.
6. To know the performance of transmission line.

.

SECTION A

INTRODUCTION: Evolution of Power Systems and Present-Day Scenario. Structure of a power system, Bulk Power Grids and Micro-grids, indoor and outdoor substations, equipment for substations, layout, auxiliary supply.
DISTRIBUTION SYSTEMS: Radial, ring mains and network distribution system, comparison of various types of ac and dc systems.

SECTION B

TRANSMISSION LINES: Calculation of line parameters, Ferranti effect, proximity effect. PERFORMANCE OF LINES: models of short, medium and long transmission lines,

performance of transmission lines, circle diagram, capacity of synchronous condenser, tuned lines, voltage control.

SECTION C

MECHANICAL DESIGN: Sag and stress calculations, effect of ice and wind, dampers. INSULATORS: Types, insulating materials, voltage distribution over insulator string, equalizer ring.

SECTION D

CABLES: Types of LV and HV cables, grading of cables, capacitance, ratings. CORONA: Phenomenon, critical voltage, power loss, reduction in losses, radio-interference, HVDC transmission – types of links, advantages and limitations.

TEXT BOOKS:

1. Power System Engg: I.J.Nagrath and D.P.Kothari (TMH)
2. Electrical Power Systems: C. L. Wadhwa (New Age International Pvt Ltd)
3. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.

REF. BOOKS:

1. Elements of power system analysis: W.D.Stevenson (MGH)
2. Electric Power System: B.M.Weedy, John Wiley & Sons.
3. Transmission & Distribution of Electrical Engineering: H.Cotton.
4. Transmission & Distribution of Electrical Engineering: Westing House & Oxford Univ. Press, New Delhi.

Transmission and Distribution Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	**PCC-EE-212G**		
Category	**Engineering Science Course**		
Course title	**Transmission and Distribution** (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

LIST OF EXPERIMENTS:

1. To study the Power System blocks in MATLAB.
2. To design short and long transmission line using MATLAB.
3. To study and calculate the transmission line parameters.
4. To study the corona loss in power distribution system.

5. To study the proximity and skin effect.
6. To find ABCD parameters of a model of transmission line.
7. To study performance of a transmission line under no load condition & under load at different power factors.
8. To observe the Ferranti effect in a model of transmission line.
9. To study performance characteristics of typical DC distribution system in radial & ring main configuration.
10. To study mechanical design of transmission line.

Mathematics-III

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

Course Code	**BSC-MATH-204G**		
Category	**Basic Science Course**		
Course title	Mathematics-III (Numerical methods, Probability and Statistics)		
Scheme	**L**	**T**	**P**
	3	**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:

The students will learn:

1. To find roots of polynomial and transcendental equations using numerical methods.
2. To conduct numerical differentiation and numerical integration.
3. To solve differential equations using numerical methods.
4. To formulate and solve problems involving random variables.
5. To apply statistical methods for analysing experimental data.

Unit-I

Numerical Methods 1: Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method, Finite differences, Interpolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae, Numerical integration, Trapezoidal rule and Simpson's 1/3rd and 3/8 rules

Unit-II

Numerical Methods 2: Taylor's series, Euler and modified Euler's methods, Runge-Kutta method of fourth order for solving first and second order ordinary differential equations, Finite difference solution of two dimensional Laplace equation and Poission equation, Implicit and

explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation

Unit-III

Probability: Probability spaces, Conditional probability, Bayes' theorem, Discrete random variables, Bernoulli distribution, Binomial distribution, Poisson distribution, Poisson approximation to the Binomial distribution, Expectation of discrete random variables, Moments, Variance of a sum, Correlation coefficient, Continuous random variables and their properties, Distribution functions and Densities, Normal, Exponential and Gamma densities

Unit-IV

Sampling: Measures of central tendency, Moments, Skewness and Kurtosis, Testing of hypothesis, Test of significance, Large sample test for single proportion, Difference of proportions, Tests for single mean, Difference of means and Difference of standard deviations, Test for ratio of variances, Chi-square test for goodness of fit and Independence of attributes

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
2. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand and Company
3. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall
5. S. Ross, A First Course in Probability, Pearson Education India
6. W. Feller, An Introduction to Probability Theory and its Applications, Wiley India

Signals and Systems

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

Course Code	**PCC-EE-214G**		
Category	**Engineering Science Course**		
Course title	**Signals and Systems** (Theory)		
Scheme	**L**	**T**	**P**
	3	**0**	**-**

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 :

On completion of the course, student will able to

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform
5. Understand the basic concept of various signals and system
6. To understand the new tool in Z transform and numerical ability to analyze the circuit in Z domain.

SECTION-A

Signals: Definition, types of signals and their representations: continuous-time, discrete-time, periodic, non-periodic, even, odd, energy, power, deterministic, random, one-dimensional, multi-dimensional, Shifting and scaling operations, Linear Time Invariant and Causal systems; commonly used signals (in continuous-time as well as in discrete-time): unit impulse, unit step,

unit ramp (and their inter-relationships), exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables).

SECTION-B

Fourier Transforms (FT):(i) Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT(ii) Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT, Sampling theorem, Applications of Fourier Transform.

SECTION-C

Time and frequency domain analysis of systems, Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter

SECTION-D

Laplace-Transform (LT) and Z-transform (ZT): (i) One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping .

Text/ Reference Books:

1. `Signal and Systems' I J NAGRATH, R. RANJAN & Sharan, 2009 Edn., TMH, New Delhi
2. V. Oppenheim, A.S. Willsky and S. Hamid Nawab, 'Signals & System',PEARSON Education, Second Edition, 2003.
3. Signals & System by A Anand Kumar, Third edition PHI.
4. Schaume Series on Signals & Systems, HSU & RANJAN, TMH,India

Electromagnetic Fields

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

Course Code	**PCC-EE-216G**		
Category	**Engineering Science Course**		
Course title	**Electromagnetic Fields** (Theory)		
Scheme	**L**	**T**	**P**
	3	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 the course, students will demonstrate the ability to:

7. Understand the basic laws of electromagnetism.
8. Obtain the electric and magnetic fields for simple configurations under static conditions.
9. Analyse time varying electric and magnetic fields.
10. Understand Maxwell's equation in different forms and different media. To understand the propagation of EM waves.

SECTION - A

Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation ,integration, vector operator del, gradient ,divergence and Curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

SECTION - B

Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

SECTION – C

Static Magnetic Fields

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Magnetic Forces, Materials and Inductance

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

SECTION – D

Time Varying Fields and Maxwell's Equations

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Electromagnetic Waves

Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

Text / References Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge UniversityPress, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

Course code	BSC-BIO-201G			
Category	Basic Science Course			
Course title	Biology For Engineers			
Scheme and Credits	L	T	P	Credits
	2	1		3
Branches (B. Tech.)	Common For All Branches			
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Each question carries equal marks. Question one will be compulsory and from all units and remaining eight questions of equal marks 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 convey that Biology is as an important scientific discipline.

To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

To convey that "Genetics is to biology what Newton's laws are to Physical Sciences"

To study the biomolecules that are basis of life.

To understand the tools used in modern genetic

engineering and its role.
To understand the role of biotechnology in different fields.

UNIT-I

Introduction to living world: Concept and definition of Biology; Aspect of biology. Need to study biology. Characteristic features of living organisms; Cell theory, Structure of Prokaryotic and Eukaryotic cell. Distinguish between animal and plant cell. Concept of single celled organisms, Types of microbes and their important properties. Economic importance of microbes.
Genetics : Mendel's laws of inheritance, Concept of allele. Concepts of recessiveness and dominance . Gene interaction.
Cell division- Mitosis and Meiosis. Evidence of nucleic acid as a genetic material. Concept of genetic code, Central Dogma.

UNIT-II

Introduction to Biomolecules: Definition, structure and important functions of carbohydrates (glucose, fructose, disaccharides, starch and cellulose), lipids (phospholipid, cholesterol), Amino acids
Proteins- structure and function. Primary secondary, tertiary and quaternary structure.
Nucleic acid- Structure of DNA and RNA, types of RNA, Watson and Crick model of DNA

UNIT-III

Introduction to Genetic Engineering: Concept of genetic engineering. Tools used in recombinant DNA Technology. Restriction enzymes and DNA modifying enzymes, ligases. Gene cloning; plasmid vector. Transgenic plants and animals

UNIT-IV

Applications of Biotechnology: Applications of biotechnology in Agriculture, Medicine, Environment (sewage treatment), enzyme technology.
Course Outcomes
After studying the course, the student will be able to:
Understand about living organisms, type of cells and microbes.
Identify DNA as a genetic material in the molecular basis of information transfer.
Get knowledge that all forms of life have the same building

blocks and yet the manifestations are as diverse as one can imagine.
Highlight the concepts of genetic engineering and application or sustainable development.
Understand the impact of biotechnology on ennironment, health agriculture and industry.
References:
1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,
L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B.
Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H.
John Wiley and Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman
and Company
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and
company, Distributed by Satish Kumar Jain for CBS Publisher
5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.
Brown Publishers
6) https://onlinecourses.nptel.ac.in/noc18_bt23 by K. Suraishkumar and Madhulika Dixit
7) Campbell, NA and Reece JB, Biology, International edition, 7th edition or later, Benjamin Cummings, New York (2007 or later)
8) Karp, G, Cell and Molecular Biology: Concepts and Experiments, 7th edition, Wiley, New York (2013)

CONSTITUTION OF INDIA

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

Course Code			
Category	**Engineering Science Course**		
Course title	**Constitution of India** (Theory)		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

CONSTITUTION OF INDIA– BASIC FEATURES AND FUNDAMENTAL PRINCIPLES

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

COURSE CONTENT

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy – Its importance and implementation.

7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

REFERENCES:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M.Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

Essence of Indian Knowledge Tradition

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

Course Code			
Category	**Engineering Science Course**		
Course title	**Essence of India Knowledge Tradition** (Theory)		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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 objective

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technologicaladvancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Contents

- Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, BharatiyaVidyaBhavan, Mumbai. 5thEdition,2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan
- Fritzof Capra, *Tao ofPhysics*
- Fritzof Capra, *The Wave oflife*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad,Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission,Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanamwith VyasaBhashya*, VidyanidhiPrakashan, Delhi2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, VidyanidhiPrakashan, Delhi2016
- P B Sharma (English translation), *ShodashangHridayan*

M.D. UNIVERSITY, ROHTAK

(NAAC Accredited 'A+' Grade)

SCHEME OF STUDIES AND EXAMINATION
B.TECH (Electrical Engineering)
SEMESTER 5th AND 6th
Scheme effective from 2020-21

COURSE CODE AND DEFINITIONS:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar
TH	Theory
Pr	Practical

General Notes:

1. Mandatory courses are non credit courses in which students will be required passing marks in internal assessments.
2. Students will be allowed to use non programmable scientific calculator. However, sharing of calculator will not be permitted in the examination.
3. Students will be permitted to opt for any elective course run by the department. However, the department shall offer those electives for which they have expertise. The choice of the students for any elective shall not be binding for the department to offer, if the department does not have expertise. To run the elective course a minimum of 1/3rd students of the class should opt for it.

Scheme of Studies and Examination
B.TECH (Electrical Engineering) – 5th Semester
w.e.f. 2020-21

Sl. No.	Course Code	Course Title	Teaching Schedule L	T	P	Marks of class work	Examination marks Theory	Practical	Total Marks	Credit	Duration of examination in hour
1.	PCC-EE-301G	Power Systems–I	3	0	0	25	75	0	100	3	3
2.	LC -EE-303G	Power Systems–I Laboratory	0	0	2	25	0	25	50	1	2
3.	PCC - EE305G	Control System	3	0	0	25	75	0	100	3	3
4.	LC-EE-307G	Control System LAB	0	0	2	25	0	25	50	1	2
5.	PCC - EE-309G	Microprocessor& Microcontroller	3	0	0	25	75	0	100	3	3
6.	LC -EE-311G	Microprocessor & Microcontroller Lab	0	0	2	25	0	25	50	1	2
7.	PCC-EE-313G	Computer Aided Electrical Machine Design	3	1	0	25	75	0	100	3	3
8.	LC-EE-315G	Computer Aided Electrical Machine Design Lab	0	0	2	25	0	25	50	1	2
9.	PEC-I	Professional Elective Courses (PEC): Refer List-I	3	0	0	25	75	0	100	3	3
10.	OEC-I	Open Elective Courses: Refer List –II	3	0	0	25	75	0	100	3	3
11.	HSMC-01G	Economics for Engineers	3	0	0	25	75	0	100	3	3
12.	PT-EE317G	Practical Training-1	-	-	-	-	-	-	* Refer Note 1		
	Total								900	25	

Note:

1. The evaluation of Practical Training-I 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 Practical Training.
2. Choose any one from Professional Elective
3. Choose any one from Open Elective

Excellent: A; Good : B; Satisfactory: C; Not Satisfactory: F.

List-I

Sr. No	Code	Subject	Credit
1	PEC-EE-01G	Wind and Solar Energy System	3
2	PEC-EE-03G	Electrical Drives	3
3	PEC-EE-05G	HVDC Transmission System	3
4	PEC-EE-07G	High Voltage Engineering	3

List-II

Sr.No	Code	Subject	Credit
1	OEC-EE01G	Electrical Engineering Materials	3
2	OEC-EE03G	Nano Electronics	3
3	OEC-EE05G	Intelligent Instrumentation	3
4	OEC-EE07G	Power Plant Engineering	3

Scheme of Studies and Examination
B.TECH (Electrical Engineering) – 6th Semester
w.e.f. 2020-21

Sl. No.	Course Code	Course Title	Teaching Schedule L	T	P	Marks of class work	Examination marks Theory	Practical	Total Marks	Credit	Duration of examination in hour
1.	PCC - EE-302G	Power Systems–II	3	0	0	25	75	0	100	3	3
2.	LC -EE-304G	Power Systems–II Laboratory	0	0	2	25	0	25	50	1	2
3.	PCC - EE-306G	Power Electronics	3	0	0	25	75	0	100	3	3
4.	LC -EE-308G	Power Electronics Laboratory	0	0	2	25	0	25	50	1	2
5.	LC -EE-310G	Electronics Design Laboratory	1	0	4	25	50	25	100	3	3
6.	PEC-II	Professional Elective Courses (PEC): Refer List-III	3			25	75	0	100	3	3
7.	PEC-III	Professional Elective Courses (PEC): Refer List-IV	3			25	75	0	100	3	3
8.	OEC-II	Open Elective Courses: Refer List –V	3			25	75	0	100	3	3
9.	HSMC - 02G	Organisational Behaviour	3			25	75	0	100	3	3
	Total								800	23	

Note:

1. Each student has to undergo practical training of 6 weeks during summer vacation after 6th semester and its evaluation shall be carried out in 7th Semester.
2. Choose any one from Professional Elective
3. Choose any one from Open Elective

List-III

PROGRAMME ELECTIVE (Semester-VI)			
Sr. No	**Code**	**Subject**	**Credit**
1.	PEC-EE-04G	Digital Signal Processing	3
2.	PEC-EE-06G	Power System Protection	3

List-IV

PROGRAMME ELECTIVE (Semester-VI)			
3.	PEC-EE-18G	Advance Electric Drives	3
4.	PEC-EE-08G	Power Quality and FACTS	3

List-V

OPEN ELECTIVE-I [Semester-VI]			
Sr.No	Code	Subject	Credit
1.	OEC-EE-04G	VHDL and DIGITAL DESIGN	3
2.	OEC-EE-06G	Distributed Energy Integration	3
3.	OEC-EE-08G	Conventional and Renewable Energy Resources	3
4.	OEC-EE-10G	Soft Computing	3

POWER SYSTEM-I

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

Course Code	PCC- EE-301G		
Category	Program Core Course		
Course title	Power System-I (Theory)		
Scheme	**L**	**T**	**P**
	3		**-**

Course Outcomes:

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

- Understand the concepts of power systems.
- Understand the various power system components.
- Evaluate fault currents for different types of faults.
- Understand basic protection schemes and circuit breakers.
- Understand concepts of HVDC power transmission and renewable energy generation.

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

Basic concepts : Introduction, Review of Three-phase systems. Analysis of simple three-phase circuits. Single-phase representation of balance three-phase network, The one-line diagram and the impedance or reactance diagram, Per unit (PU) system, Complex power, The steady state model of synchronous machine, Transmission of electric power, Representation of loads.

Section-B

Fault Analysis : Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults.Representation of generators, lines and transformers in sequence networks.Computation of Fault Currents.Neutral Grounding.

Section-C

Switchgear and protection: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application

Section-D

Introduction to DC Transmission & Solar PV systems: DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission.

Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators.

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012
6. EHV-AC/DC Transmission System ;S.Rao : Khanna Pub.
7. C.L Wadhwa, " Electrical Power system" new age publication.
8. Power System Protection & Switchgear By B. Ram, McGraw Hill
9. https://nptel.ac.in/courses/108/106/108106160/ by Prof. Krishna S, IIT Madras.
10. https://nptel.ac.in/courses/117/105/117105140/ by Prof. D. Das, IIT, Khahargpur.

Power System-I Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	LC-EE-303G		
Category	Program Core Course		
Course title	Power system-I (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

LIST OF EXPERIMENTS:

(A) Hardware Based:

1. To determine negative and zero sequence reactances of an alternator.
2. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
3. To study the IDMT over current relay and determine the time current characteristics
4. To study percentage differential relay
5. To study Impedance, MHO and Reactance type distance relays
6. To study ferranti effect and voltage distribution in H.V. long transmission line using transmission line model.
7. To study operation of oil testing set.
8. To understand PV modules and their characteristics like open circuit voltage, short circuit current, Fill factor, Efficiency,
9. To understand I-V and P-V characteristics of PV module with varying radiation and temperature level
10. To understand the I-V and P-V characteristics of series and parallel combination of PV modules.
11. To understand wind energy generation concepts like tip speed, torque and power relationship, wind speed versus power generation

(B) Simulation Based Experiments (using software)

12. To obtain steady state, transient and sub-transient short circuit currents in an alternator
13. To perform symmetrical fault analysis in a power system
14. To perform unsymmetrical fault analysis in a power system

Note:

1. Each laboratory group shall not be more than about 20 students.
2. To allow fair opportunity of practical hands on experience to each student, each experiment may either done by each student individually or in group of not more than 3-4 students. Larger groups are strictly discouraged/disallowed.

3.

Control system

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

Course Code	PCC-EE-305G		
Category	Program Core Course		
Course title	Control Systems		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

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 modellingof linear-time-invariant systems using transfer function and state-space representations.
- Understandthe concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Section-A

Introduction to control problem (4 hours)

Industrial control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems, benefits of feedback, block diagram algebra, signal flow graphs.

Time Response Analysis (10 hours)

Standard test signals. Time response of first and second order systems for standard test inputs.Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability.Routh-Hurwitz Criteria.Relative Stability analysis.Root-Locus technique.Construction of Root-loci.

Section-B

Frequency-response analysis (6 hours)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Section-C

Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design.Application of

Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.Analog and Digital implementation of controllers.

Section-D

State variable Analysis (6 hours)

Concepts of state variables.State space model.Diagonalization of State Matrix.Solution of state equations.Eigenvalues and Stability Analysis.Concept of controllability and observability.

Text/References:

1. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
2. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
3. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.
4. B.S.Manke, "Linear Control Systems: with MATLAB application", Khanna Publication.
5. https://nptel.ac.in/courses/107/106/107106081/ by Prof.C.S Shankar Ram, IIT Madras.

Control Systems Laboratory

Theory : 25
Class Work : 25
Total : 50

Course Code	LC-EE-307G		
Category	Program Core Course		
Course title	Control Systems Laboratory		
Scheme	**L**	**T**	**P**
	-	**-**	**02**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS: ANY SIX EXPERIEMENTS

1. To study speed Torque characteristics of

a) A.C. servo motor b) DC servo motor.

2. (a) To demonstrate simple motor driven closed loop DC position control system.

(b) To study and demonstrate simple closed loop speed control system.

3. To study the lead, lag, lead-lag compensators and to draw their magnitude and phase plots.

4. To study a stepper motor & to execute microprocessor or computer-based control of the same by changing number of steps, direction of rotation & speed.

5. To implement a PID controller for temperature control of a pilot plant.

6. To study behavior of 1^{st} order, 2^{nd} order type 0, type 1 system.

7. To study control action of light control device.

8. To study water level control using a industrial PLC.

9. To study motion control of a conveyor belt using a industrial PLC

Software Based (ANY FOUR EXPT.)

10. Introduction to software (Control System Toolbox), Implement at least any

- Different Toolboxes in software, Introduction to Control Systems Toolbox.
- Determine transpose, inverse values of given matrix.
- Plot the pole-zero configuration in s-plane for the given transfer function. Plot unit step response of given transfer function and find peak overshoot, peak time.
- Plot unit step response and to find rise time and delay time.

- Plot locus of given transfer function, locate closed loop poles for different values of k.
- Plot root locus of given transfer function and to find out S, Wd, Wn at given root & to discuss stability.
- Plot bode plot of given transfer function and find gain and phase margins Plot the Nyquist plot for given transfer function and to discuss closed loop stability, gain and phase margin.

Microprocessor and Microcontroller

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

Course Code	PCC-EE-309G		
Category	Program Core Course		
Course title	Microprocessor and Microcontroller		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

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.

Objective:

1. To develop an in-depth understanding of the operation of microprocessors.
2. To master the assembly language programming using concepts like assembler directives, procedures, macros, software interrupts etc.
3. To create an exposure to basic peripherals, its programming and interfacing techniques
4. To understand the concept of Interrupts and interfacing details of 8086.
5. To impart the basic concepts of serial communication in 8086.

Section-A

8086 MICROPROCESSORS

Introduction to 8086 Architecture, Features, Signals, I/O & Memory Interfacing, Addressing Modes, Interrupts, Minimum Mode & Maximum Mode Operation, Instruction Set, Assembly Language Programming.

Section-B

PERIPHERAL DEVICES

Parallel Peripheral Interface (8255), A/D & D/A Interface, Timer / Counter (8253), Keyboard and Display Controller (8279), USART (8251), Interrupt Controller (8259), DMA Controller (8237)

Section-C

INTRODUCTION OF MICROCONTROLLER

Different types of microcontrollers: Embedded microcontrollers, External memory microcontrollers; Processor Architectures: Harvard V/S Princeton , CISC V/S RISC; microcontrollers memory types; microcontrollers features : clocking, i/o pins, interrupts,timers, peripherals.

Section-D

8051 ARCHITECTURE

Microcontroller 8051- Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing, Instruction Set, Assembly Language Programming, Real Time Applications of Microcontroller- Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors.

Reference Books:

1. Mazidi and Mazidi: The 8051 Microcontroller and Embedded Systems, Pearson Education.
2. A. V. Deshmukh: Microcontroller (Theory and Application), TMH.
3. D. V. Hall: Microprocessors and Interfacing, TMH
4. Programming and Customizing the 8051 Microcontroller :Predko ; TMH.

Microprocessor and Microcontroller Lab

Theory :	25
Class Work :	25
Total :	50

Course Code	LC-EE-311G		
Category	Program Core Course		
Course title	Microprocessor and Microcontroller Lab		
Scheme	**L**	**T**	**P**
	-	**-**	**02**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

List of Experiments:

1. Write a program using 8085 and verify for :
   a. Addition of two 8-bit numbers.
   b. Addition of two 8-bit numbers (with carry).
2. Write a program using 8085 and verify for :
   a. 8-bit subtraction (display borrow)
   b. 16-bit subtraction (display borrow)
3. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method. Check for minimum number of additions and test for typical data.
4. Write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.
5. Write a program using 8086 for finding the square root of a given number and Verify.
6. Write a program using 8086 for copying 12 bytes of data from source to destination and verify.
7. Write a program using 8086 and verify for:
   a. Finding the largest number from an array.
   b. Finding the smallest number from an array.
8. Write a program using 8086 for arranging an array of numbers in descending order and verify.
9. Write a program using 8086 for arranging an array of numbers in ascending order

and verify.

10. Write a program to interface a two digit number using seven-segment LEDs. Use 8085/8086 microprocessor and 8255 PPI.
11. Write a program to control the operation of stepper motor using 8085/8086 microprocessor and 8255 PPI.
12. To study implementation & interfacing of Display devices Like LCD, LED Bar graph& seven segment display with Microcontroller 8051/AT89C51
13. To study implementation & interfacing of Different motors like stepper motor, DC motor & servo Motors.
14. Write an ALP for temperature & pressure measurement
15. Write a program to interface a graphical LCD with 89C51

COMPUTER AIDED ELECTRICAL MACHINE DESIGN

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

Course Code	PCC-EE-313G		
Category	Program Core Course		
Course title	COMPUTER AIDED ELECTRICAL MACHINE DESIGN		
Scheme	**L**	**T**	**P**
	03	**-**	**-**

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.

COURSE OUTCOMES:

- To understand the features and limitations of electrical machine design.
- To understand the specified limits for Specific electric and magnetic loading.
- To understand the basic design procedure for transformer, d.c. machine, induction motor and synchronous machine individually.
- To explain the complete detailed design of all static and rotating machine and their performance with problems.
- To understand about the computerization of the design procedure.
- Analyze the design procedure and performance of various algorithms.
- Synthesize efficient algorithm and make a flow chart for all static and rotating machine.
- Analyze the optimization technique and their application to design problem.

SECTION A

FUNDAMENTAL ASPPECTS OF ELECTRICAL MACHINE DESIGN: Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques.

BASIC DESIGN PRINCIPLES: Output equation and output coefficient, Specific electric and magnetic
loading. Relation between rating and main dimension of rotating machine, Effect of size and ventilation/Factors affecting size of a rotating machine.

SECTION B

DESIGN OF INDUCTION MOTORS: Three Phase Induction Motor: Standard specifications, output equations, choice of specific loadings, main dimensions, conductor size and turns, air gap length, no. of slots, slot design, stator core depth, rotor design, rotor bars& slots area, end rings .

SECTION C

DESIGN OF TRANSFORMER: Output Equations of Single Phase and Three Phase Transformers, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, Main Dimensions - kVA output for single and three phase transformers, Window space factor, Design of core, yoke and winding, overall dimensions.

DESIGN OF SYNCHRONOUS MACHINE: Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding.Design of Salient and

non- salient Pole Rotors.Magnetic Circuit and Field Winding, design difference between turbo alternator & salient pole generators.

SECTION D

DESIGN OF DC MACHINES: Output equation, choice of specific loadings, choice of poles and speed, Design of core length, armature diameter, depth of armature core,air gap length, cross section of armature conductors, armature slots ,design of field system field poles, field coils, commutator.

COMPUTER AIDED DESIGN: Computerization of design Procedures. Development of Computer program and performance prediction. Optimization techniques and their applications to design Problems.

TEXT BOOKS:

1. A course in Electrical Machine Design by A.K. Sawhney, Khanna Pub.
2. Princilplesof Electrical Machine Design by R. K. Aggarwal.

REFERENCE BOOKS:

1. Theory, performance and Design of alternating current machines by MG Say, ELBS, 15th Ed. 1986.
2. Theory, Performance and Design of Direct Current machines by A.E. Clayton, 3rd Ed. 1967.
3. Optimization Techniques, S.S. Rao

COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB

Theory :	25
Class Work :	25
Total :	50

Course Code	LC-EE-315G		
Category	Program Core Course		
Course title	COMPUTER AIDED ELECTRICAL MACHINE DESIGN LAB		
Scheme	**L**	**T**	**P**
	-	**-**	**02**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS

1. To study about design factors and its limitations.
2. To study about CAD of rotating electrical machine.
3. To study of computer aided design of transformer.
4. Write a program to measure the main dimension of an induction motor.
5. Write a program for stator design of an induction motor.
6. Write a program for rotor design of an induction motor.
7. Write a program to measure the losses and the efficiency of an induction motor.
8. Write a program to design the armature of a D.C. motor.
9. Write a program to measure the slot design of a synchronous machine.
10. Write a program to measure the core and yoke design of transformer.
11. Write a program to measure the losses in a transformer.

References for software:

1. SPEED
2. MOTORSOLVE
3. FLUX, MAGNET
4. AANSYS RMxprt/Maxwell 2D/3D
5. Motor Design Limited

Wind and Solar Energy Systems

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

Course Code	PEC- EE-01G		
Category	PROGRAMM ELECTIVE		
Course title	Wind and Solar Energy Systems		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

Course Outcomes:

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

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

Section-A

Introduction to Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Section -B

Wind generator topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Section -C

Solar photovoltaic: Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis

Section -D

Network Integration Issues: Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behaviour during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Text / References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.

3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.

4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.

5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.

6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

Electric Drives

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

Course Code	PEC-EE-03G		
Category	PROGRAMM ELECTIVE		
Course title	Electrical Drives		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

Course Outcomes:

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

- Understand the characteristics of dc motors and induction motors.
- Understand the principles of speed-control of dc motors and induction motors.
- Understand the power electronic converters used for dc motor and induction motor speed control.

SECTION-A

Electrical drives

Introduction, Classification, advantages, choice of electrical drive machines, status of ac and dcdrives.

DC motor characteristics

Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation.

Closed-loop control of DC Drive

Control structure of DC drive, inner current loop and outer speed loop, closed-loop speed control of multi-motor drives, microprocessor-based control of electric drives, current controller specification and design, speed controller specification and design.

SECTION-B

Multi-quadrant DC drive

Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine, single-quadrant, two-quadrant and four-quadrant choppers, steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Selection of motor power rating

Heating and cooling, determination of motor rating, continuous, short time and intermittent duty rating, load equalization and determination of moment of inertia of the flywheel.

SECTION-C

Chopper fed DC drive

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Induction motor characteristics

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torquespeed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

SECTION-D

Scalar control or constant V/f control of induction motor

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Control of slip ring induction motor

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

Text / Reference Books:

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.
3. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
4. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

High Voltage Engineering

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

Course Code	PEC-EE-07G		
Category	PROGRAMM ELECTIVE		
Course title	High Voltage Engineering		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

Objective: To impart knowledge on the following Topics

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

Section A

Conduction and Breakdown in Gases:

Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Experimental Determination of Coefficients α and γ, Breakdown in Electronegative Gases, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges.

Conduction and Breakdown in Liquid Dielectrics:

Liquids as Insulators, Pure Liquids and Commercial Liquids, Conduction and Breakdown in Pure Liquids, Conduction and Breakdown in Commercial Liquids.

Breakdown in Solid Dielectrics:

Introduction, Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown.

Section B

Generation of High Voltages and Currents:

Generation of High Direct Current Voltages, Generation of High Alternating Voltages, Generation of Impulse Voltages, Generation of Impulse Currents, Tripping and Control of Impulse Generators.

Measurement of High Voltages and Currents:

Measurement of High Direct Current Voltages, Measurement of High AC and Impulse Voltages, Measurement of High Currents – Direct, Alternating and Impulse, Cathode Ray Oscillographs for Impulse Voltage and Current Measurements.

Section C

Overvoltage Phenomenon and Insulation Coordination in Electric Power Systems:

National Causes for Overvoltages - Lightning Phenomenon, Overvoltage due to Switching Surges, System Faults and Other Abnormal, Principles of Insulation Coordination on High Voltage and Extra High Voltage Power Systems.

Non-Destructive Testing of Materials and Electrical Apparatus:

Introduction, Measurement of Dielectric Constant and Loss Factor, Partial Discharge Measurements.

Section D

HV Testing of Electrical Apparatus:

Testing of Insulators and Bushings, Testing of Isolators and Circuit Breakers, Testing of Cables, Testing of Transformers, Testing of Surge Arrestors, Radio Interference Measurements, Testing of HVDC Valves and Equipment.

Graduate Attributes (As per NBA)

Engineering Knowledge, Problem Analysis, Design/ Development of Solutions, Modern Tool Usage, Ethics, Individual and Team Work, Communication, Life-long Learning.

Course outcomes:

At the end of the course the student will be able to:

- Explain conduction and breakdown phenomenon in gases, liquid dielectrics.
- Analyse breakdown phenomenon in solid dielectrics.
- Explain generation of high voltages and currents
- Analyse measurement techniques for high voltages and currents.
- Discuss overvoltage phenomenon and insulation coordination in electric power systems.
- Perform non-destructive testing of materials and electric apparatus and high-voltage testing of electric apparatus

Reference Books

- High Voltage Engineering M.S. Naidu, V.Kamaraju McGraw Hill ‘Latest Eddition’.
- High Voltage Engineering Fundamentals E. Kuffel, W.S. Zaengl, J. Kuffel Newnes ‘Latest Eddition’
- High Voltage Engineering Wadhwa C.L. New Age International ‘Latest Eddition’
- High-Voltage Test and Measuring Techniques Wolfgang Hauschild • Eberhard Lemke Springer ‘Latest Eddition’
- High Voltage Engineering Farouk A.M. Rizk CRC Press ‘Latest Eddition’

HVDC Transmission Systems

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

Course Code	PEC-EE-07G		
Category	PROGRAMM ELECTIVE		
Course title	HVDC Transmission Systems		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

Objective: To impart knowledge on the following Topics

- DC power transmission technology Analysis of HVDC converters
- Converter and HVDC system control
- Converter faults and protection
- Smoothing reactor and DC line
- Reactive power control
- Component models for the analysis of ac/dc systems
- Power flow analysis in AC/DC systems

Section A

BASIC CONCEPTS

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

ANALYSIS OF HVDC CONVERTERS

Choice of Converter configuration – analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

Section B

CONVERTER & HVDC SYSTEM CONTROL

Principal of DC Link Control – Converters Control Characteristics – Firing angle control Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

REACTIVE POWER CONTROL IN HVDC

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies sources of reactive power-AC Filters – shunt capacitors-synchronous condensers.

Section C

POWER FLOW ANALYSIS IN AC/DC SYSTEMS

Modelling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for d.c. quantities-solution of AC-DC Power flow-Simultaneous method-Sequential method.

CONVERTER FAULT & PROTECTION

Converter faults – protection against over current and over voltage in converter station – surge arresters – smoothing reactors – DC breakers –Audible noise-space charge field-corona effects on DC lines-Radio interference.

Section D

HARMONICS

Generation of Harmonics –Characteristics harmonics, calculation of AC Harmonics, Non-Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics

FILTERS

Types of AC filters, Design of Single tuned filters –Design of High pass filters.

Course Outcome

After the completion of the course, the students will be able to:

1. Choose intelligently AC and DC transmission systems for the dedicated application(s).
2. Identify the suitable two-level/multilevel configuration for high power converters.
3. Select the suitable protection method for various converter faults.
4. Identify suitable reactive power compensation method.
5. Decide the configuration for harmonic mitigation on both AC and DC sides.

REFERENCES:

1. HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar,
New Age International (P) Limited, and Publishers.
2. EHVAC and HVDC Transmission Engineering and Practice – S.Rao.
3. HVDC Transmission – J.Arrillaga.
4. Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons.
5. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications.
6. Arrillaga, J., HVDC Transmission, IEE Press ‘Latest Edition’.

ELECTRICAL ENGINEERING MATERIALS

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

Course Code	OEC-EE-14G		
Category	OPEN ELECTIVE		
Course title	ELECTRICAL ENGINEERING MATERIALS		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

COURSE OUTCOME:

After the completion of the course, the students will be able to:

- Learn the basics of materials used in electrical engineering.
- Realize the dielectric properties of insulators in static and alternating fields.
- Explain the importance of magnetic properties and superconductivity.
- Explain the behavior of conductivity of metals and classifications of semiconductor material.

SECTION A

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

SECTION B

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, dielectric losses, significance of the loss tangent, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity

SECTION C

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

SECTION D

Semiconductors: energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

REFERENCE BOOKS

[1] C.S.Indulkar and S. Thiruvengadam, S., “An Introduction to Electrical Engineering
[2] Kenneth G. Budinski,, “Engineering Materials: Prentice Hall of India, New Delhi

Nano Electronics

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

Course Code	OEC-EE-04G		
Category	Open Elective		
Course title	Nano Electronics (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

Course Outcomes:

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

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material

Section-1

Introduction to nanotechnology, Basics of Quantum Mechanics: Wave nature of particles and wave-particle duality, Pauli Exclusion Principle, wave functions and Schrodinger's equations, Density of States, Band Theory of Solids, Particle in a box Concepts,

Section-I1

Shrink-down approaches: CMOS scaling: advantages and limitations. Nanoscale MOSFETs, FINFETs, Vertical MOSFETs, system integration limits (interconnect issues etc.)

Section-II1

Nanostructure materials, classifications of nanostructure materials, zero dimensional, one dimensional, two dimensional and three dimensional, properties and applications Characterization techniques for nanostructured materials: SEM, TEM and AFM

Section-1V

Nano electronis devices : Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Text/Reference Books:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic

Materialand Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University
Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

Intelligent Instrumentation

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

Course Code	OEC- EE-302G		
Category	Open Elective Course		
Course title	Intelligent Instrumentation (Theory)		
Scheme	**L**	**T**	**P**
	3		**-**

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.

Course Outcomes:

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

1. The basic characteristic of intelligent instrumentation system includes the knowledge of new sensor technology.
2. Able to understand the data acquisition system.
3. Able to understand the signal amplification & attenuation

Section-A

Intelligence, features characterizing intelligence, intelligent instrumentation system: features of intelligent instrumentation, components of intelligent instrumentation, block diagram of intelligent instrumentation.

Section-B

Signal amplification & attenuation (OP-AMP based), instrumentation amplifier (circuit diagram, high CMRR & other features), signal linearization(different types such as diode resistor combination, OP-AMP based etc.), bias removal signal filtering (output from ideal filters, output from constant – k filters, matching of filter sections, active analog filters).

Section-C

OP-AMP based voltage to current converter, current to voltage conversion, signal integration, voltage follower (pre amplifier), voltage comparator, phase locked loop, signal addition, signal multiplication, signal transmission, description of spike filter.

Smart sensors: Primary sensors, excitation, compensation, information coding/processing, data compensation, standard for smart sensor interface.

Section-D

Interfacing instruments and computers: basic issues of interfacing address decoding; data transfer control, A/D convertor, D/A convertors, sample & hold circuit, other interface considerations.

Text Books:

1. Principles of measurements and instrumentation by Alan S Morris, PHI
2. Intelligent instrumentation by Bamay, G.C.Prentice Hall

Reference Books :

1. Sensors and transducers by Parranabis, PHI
2. Introduction to digital signal processing: MGH

Power Plant Engineering

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

Course Code	OEC-EE07G		
Category	OPEN ELECTIVE		
Course title	Power Plant Engineering		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

Course Outcomes:

1. Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
2. Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts
3. Able to know about the different types of cycles and natural resources used in power plants and their application.
4. Discuss and analyze the mathematical and working principles of different electrical equipments involved in the generation of power.

Section-A

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Section-B

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Section-C

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Section-D

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

ECONOMICS FOR ENGINEERS

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

Course Code	HSMC-01G		
Category	HS		
Course title	ECONOMICS FOR ENGINEERS		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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 Objectives:

1. Acquaint the students to basic concepts of economics and their operational significance.
2. To stimulate the students to think systematically and objectively about contemporary economic problems.

COURSE OUTCOMES:

1. The students will able to understand the basic concept of economics.
2. The student will able to understand the concept of production and cost.
3. The student will able to understand the concept of market.
4. The student will able to understand the concept of privatization, globalization and banks.

UNIT-1

Definition of Economics- Various definitions, types of economics- Micro and Macro Economics, nature of economic problem, Production Possibility Curve, Economic laws and their nature, Relationship between Science, Engineering, Technology and Economic Development.

Demand- Meaning of Demand, Law of Demand, **Elasticity of Demand**- meaning, factors effecting it, its practical application and importance.

UNIT-2

Production- Meaning of Production and factors of production, Law of variable proportions, Returns to scale, Internal and external economies and diseconomies of scale.

Various concepts of cost of production- Fixed cost, Variable cost, Money cost, Real cost, Accounting cost, Marginal cost, Opportunity cost. Shape of Average cost, Marginal cost, Total cost etc. in short run and long run.

UNIT-3

Market- Meaning of Market, Types of Market- Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly (main features).

Supply- Supply and law of supply, Role of demand & supply in price determination and effect of changes in demand and supply on prices.

UNIT-4

Indian Economy- Nature and characteristics of Indian economy as under developed, developing and mixed economy (brief and elementary introduction), **Privatization -** meaning, merits and demerits.

Globalization of Indian economy - merits and demerits.

Banking- Concept of a Bank, Commercial Bank- functions, Central Bank- functions, Difference between Commercial & Central Bank.

REFERENCES:

1. Jain T.R., Economics for Engineers, VK Publication.
2. Chopra P. N., Principle of Economics, Kalyani Publishers.
3. Dewett K. K., Modern economic theory, S. Chand.
4. H. L. Ahuja., Modern economic theory, S. Chand.
5. Dutt Rudar & Sundhram K. P. M., Indian Economy.
6. Mishra S. K., Modern Micro Economics, Pragati Publications.
7. Singh Jaswinder, Managerial Economics, dreamtech press.
8. A Text Book of Economic Theory Stonier and Hague (Longman's Landon).
9. Micro Economic Theory – M.L. Jhingan (S.Chand).
10. Micro Economic Theory - H.L. Ahuja (S.Chand).
11. Modern Micro Economics : S.K. Mishra (Pragati Publications).
12. Economic Theory - A.B.N. Kulkarni & A.B. Kalkundrikar (R.Chand & Co).

POWER SYSTEM-II

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

Course Code	PCC- EE-302G		
Category	Program Core Course		
Course title	Power System – II (Theory)		
Scheme	**L**	**T**	**P**
	3	**-**	**-**

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.

Course Outcomes:

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

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the basics of power system economics

SECTION-A

Power Flow Analysis : Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations.

Section -B

Economic Operation of Power Systems: Distribution of loads between units within a plant. Distribution of loads between plants, Transmission loss equation, Classical Economic dispatch with losses.Optimal unit commitment problems and their solutions.

Section -C

Voltage and Load Frequency Control: Introduction to control of active and reactive power flow, control of voltage, Excitation systems. Introduction to Load Frequency Control and Automatic generation control, Single area and modelling of AGC, Concept of multi area AGC.

Section -D

Power System Stability: Concepts, steady state and transient stability, swing equations, equal area criterion. Solution of Swing Equation, Transient stability algorithm using modified Euler's method and fourth order RungeKutta method,– multi-machine stability analysis

Text/References:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.
6. https://nptel.ac.in/courses/117/105/117105140/ by Prof. D. Das, IIT, Khahargpur.

Power system-II (Lab)

Theory :	25
Class Work :	25
Total :	50

Course Code	PCC-EE-304G		
Category	Program Core Course		
Course title	Power system-II(Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(i) At least 10 experiments are to be performed by students in the semester.

(ii) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus

(iii) Group of students for practical should be 15 to 20 in number.

LIST OF EXPERIMENTS:

1. Draw the flow chart and develop the computer program for the formation of the Y Bus of a generalized network.
2. Draw the flow chart and develop the computer program for the formation of the Z Bus of a generalized network.
3. To plot the swing curve and observe the stability.
4. To perform load flow analysis using Gauss Seidel method.
5. To perform load flow analysis using Newton-Raphson method.
6. To study comparison of different load flow methods
7. To develop the program for stability analysis.
8. To observe transmission losses and efficiency with variations in power for the given example.
9. Simulation study on LFC of two area interconnected power system.
10. Simulation study on voltage control in multi area interconnected power system.

Power Electronics

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

Course Code	**PCC-EE-306**		
Category	**Engineering Science Course**		
Course title	**Power Electronics**(Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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 differences between signal level and power level devices.
- Analyse controlled rectifier circuits.
- Analyse the operation of DC-DC choppers.
- Analyse the operation of voltage source inverters.

Section-A

INTRODUCTION : Role of power electronics, review of construction and characteristics of power diode, Shottky diode, power transistor, power MOSFET, DIAC, Triac, GTO, IGBT & SIT.

Section-B

SCR: construction and characteristics of SCR,Ratings and protections, series and parallel connections, R, RC and UJT firing circuit and other firing circuits based on ICs and microprocessors, pulse transformer and opto-coupler, commutation techniques.

Section-C

THYRISTOR RECTIFIER: Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

CONVERTERS : One, two, three, six and twelve pulse converters, fully and half controlled converters, load voltage waveforms, output voltage equation, continuous and discontinuous modes of operation, input power factor of converter, reactive power demand, effect of source inductance, introduction to four quadrant / dual converter, power factor improvement techniques, forced commutated converter

Section-D

INVERTERS : Basic circuit, 120 degree mode and 180 degree mode conduction schemes, modified McMurray half bridge and full bridge inverters, McMurray -Bedford half bridge and bridge inverters, brief description of parallel and series inverters, current source inverter (CSI)

CHOPPERS : Basic scheme, output voltage control techniques, one, two, and four quadrant choppers, step up chopper, voltage commutated chopper, current commutated chopper

TEXT BOOK:

1. P.S Bhimra, “Power Electronics”, Khanna publication.
2. MH Rashid, “Power Electronics “, PHI
3. Bose, “Power electronics”,Elsevier

REFERENCE BOOKS :

1. MH Rashid, “Handbook of power electronics “, Elsevier

2. PC Sen, “Power Electronics”, TMH
3. HC Rai, “Power Electronics”, Galgotia
4. GK Dubey, “Thyristorised Power Controllers”,PHI
5. A.K.Gupta and L.P.Singh, “Power Electronics and Introduction to Drives”,.Dhanpat Rai

Power Electronics Laboratory

Class Work: 25
Exam : 25
Total : 50

Course Code	PCC-EE-308		
Category	Engineering Science Course		
Course title	Power Electronics (Laboratory)		
Scheme	**L**	**T**	**P**
	-	**-**	**2**

Notes:

(iv) At least 10 experiments are to be performed by students in the semester.

(v) At least 7 experiments should be performed from the list, remaining three experiments may either be performed from the above list or designed and set by the concerned institution as per the scope of the syllabus.

(vi) Group of students for practical should be 15 to 20 in number.

List of Experiments

1. Static Characteristics of Power diode &Shottky diode and to study reverse recovery of Power Diode &Shottky diode.
2. Characteristics of IGBT & GTO
3. To study R, RC and UJT firing Circuit with Pulse transformer
4. To study of Firing Circuit based on ICs NE555, 7408 & 3140
5. To Study of Pulse transformer & optocoupler technique
6. To Study of SCR Communication Technique Class A-E.
7. Speed control of small motor using Single Phase Half wave & Full wave fully controlled Converter
8. Speed control of small motor using Single Phase Dual Converter (Continuous and discontinuous Control)
9. Study of Mc Murray - Bed ford Half & Full Bridge Inverter
10. To study Parallel Inverter to drive small AC Induction motor
11. Speed control of a small DC motor using MOSFET based Chopper with output voltage control technique
12. Speed control of small AC induction motor using Single Phase non circulating type bridge by frequency conversion.

Electronics Design (Integrated)

Class Work: 25
Exam : 75
Total : 100

Course Code	**PCC -EE-310G**		
Category	**Engineering Science Course**		
Course title	**Electronics Design (** Integrated)		
Scheme	**L**	**T**	**P**
	1	**-**	**4**

Notes:

- Understand the practical issues related to practical implementation of applications.
- Choose appropriate components, software and hardware platforms.
- Design a Printed Circuit Board, get it made and populate/solder it with components.
- Work as a team with other students to implement an application.

Section-A

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits

Section-B

Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems

Section-C

Embedded systems, Electronic system design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations.

Section-D

Groupprojects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Text/Reference Books

1. A. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
3. H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.
5. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

*The experiments will be performed on the basis of above contents.

Digital signal processing

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

Course Code	PEC-EE-04G		
Category	Program Elective		
Course title	Digital Signal Processing (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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 the course, students will demonstrate the ability to:

1. To get an introduction of basics like Sampling, Interpolation, Aliasing and operations, Convolution and Correlation.
2. To Study the basics, mathematical analysis and applications of DFT and FFT
3. To study the design and implementation of Digital Filters.
4. To impart practical knowledge of signal processing operations by using software.

UNIT I

Discrete-Time Signals and Systems: Sequences; representation of signals on orthogonal basis; representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Z-Transform: Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z- transforms, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

UNIT II

Frequency Representation of Signal and Systems: Frequency Domain analysis concept, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Circular convolution, Linear Filtering using DFT, Fast Fourier Transform Algorithm, Decimation in time and Decimation in frequency algorithms, Computations Complexity Calculations, Parsevals Identity.

UNIT III

Design of Digital Filter : Ideal Filter vs Practical Filters, General Specifications and Design Steps, Comparison of FIR & IIR Filters, Design of FIR Filters using Window technique, Park-McClellan's method, Design of IIR Filters using Impulse Invariance technique, Bilinear Transformation, Design of IIR Filters using Butterworth, Chebyshev and Elliptic filter, Digital frequency transformation.

UNIT IV

Implementation of Discrete Time Systems: Block diagrams and signal flow graphs for FIR and IIR systems, Direct form, Cascade form, Frequency Sampling Structures, and Lattice

structures for FIR systems, Direct form, Cascade form, Parallel form, and Lattice and Lattice-Ladder Structures for IIR systems, Representation of fixed point and floating point numbers, Finite word length effects, Parametric and non-parametric spectral estimation. Applications of Digital Signal Processing

Multirate Digital Signal Processing: Introduction to multirate digital signal processing, Multi rate structures for sampling rate conversion, Multistage decimator and interpolators, Polyphase decomposition, Digital Filter Banks.

Text/Reference
Books:

1 John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
4. Digital Signal Processing: Salivahanan, Vallavaraj and Gnanapriya;TMH
5. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
6. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
7. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Power system protection

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

Course Code	**PEC-EE-06G**		
Category	**Program Elective**		
Course title	**Power system protection** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

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

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of wide-area measurements.

Section A

Introduction and Components of a Protection System

Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers , Generator Protection: External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation.

Section B

Faults and Over-Current Protection: Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

Transformer protection: Differential protection – self-balance system of protection – over-current and earth fault protection – buchholz' s relay and its operation.

Section C

Equipment Protection Schemes: Directional, Distance, Differential protection. Bus bar Protection, Bus Bar arrangement schemes.

Modeling and Simulation of Protection Schemes : CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Section D

System Protection

Effect of Power Swings on Distance Relaying.System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Text/References :

1. J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, New York, 1987.

2. Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India, 2010.3. A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 1988.

4. A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 2008.

5. D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.

Advance Electric Drives

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

Course Code	**PEC-EE-18G**		
Category	**Program Elective**		
Course title	**Advance Electric Drives** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

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

- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for ac motor drives
- Understand the implementation of the control strategies using digital signal processors.

Section A

Power Converters for AC drives

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Section B

Induction motor drives

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC)

Section C

Synchronous motor drives

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Permanent magnet motor drives

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Section D

Switched reluctance motor drives

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

DSP based motion control

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Text / Reference Books:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.

2. P.C. Krause, O. Wasynczuk and S.D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.

3. H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003.
4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.

Power quality and FACTS

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

Course Code	**PEC-EE-08G**		
Category	**Program Elective**		
Course title	**Power quality and FACTS**(Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

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

1. Understand the characteristics of ac transmission and the effect of shunt and series reactive Compensation.
2. Understand the working principles of FACTS devices and their operating characteristics.
3. Understand the basic concepts of power quality.
4. Understand the working principles of devices to improve power quality.

Section A

Transmission Lines and Series/Shunt Reactive Power Compensation: Introduction to power quality and their issues, Basics of AC Transmission. Analysis of uncompensated AC transmission lines.Passive Reactive Power Compensation.Shunt and series compensation at the mid-point of an AC line.Comparison of Series and Shunt Compensation.

Thyristor-based Flexible AC Transmission Controllers (FACTS): Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Section B

Voltage Source Converter based (FACTS) controllers: Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Section C

Application of FACTS: Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Power Quality Problems in Distribution Systems: Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags,

Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

Section D

DSTATCOM: Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents.Current Control Techniques in for DSTATCOM.

Dynamic Voltage Restorer and Unified Power Quality Conditioner: Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering.Unified Power Quality Conditioner (UPQC): Working Principle.Capabilities and Control Strategies.

Text/References

1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.

2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.

3. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983. 4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.

VHDL AND DIGITAL DESIGN

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

Course Code	OEC-EE03G		
Category	OPEN ELECTIVE		
Course title	VHDL and Digital Design		
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 Objective:

1. To understand the modelling & simulation & its role in digital evaluation.
2. To learn basic concepts of VHDL language, its different architecture, designing of various Combinational & sequential circuits.
3. To study various PLDs & detail study of FPGAs and implementation of various combinational & sequential logic circuits on FPGAs.

UNIT-1

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 behavioral dataflow and structural models.

UNIT- 2

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.

UNIT -3

COMBINATIONAL & SEQUENTIAL CIRCUIT DESIGN:VHDL Models and Simulation of combinational circuits such as Multiplexers, Demultiplexers, encoders, decoders , code converters, comparators, implementation of Boolean functions etc. VHDL Models and Simulation of Sequential Circuits Shift Registers, Counters etc.

UNIT-4

DESIGN OF MICROCOMPUTER & PROGRAMMABLE DEVICE: Basic components of a computer, specifications, architecture of a simple microcomputer system, and

implementation of a simple microcomputer system using VHDL Programmable logic devices: ROM, PLAs, PALs, GAL, PEEL, CPLDs and FPGA. Design implementation using CPLDs and FPGAs

REFERENCE BOOKS:

1. Ashenden - Digital design,Elsevier
2. IEEE Standard VHDL Language Reference Manual (1993).
3. Digital Design and Modelling with VHDL and Synthesis: KC Chang; IEEE Computer Society Press.
4. "A VHDL Primmer" : Bhasker; Prentice Hall 1995.
5. "Digital System Design using VHDL" : Charles. H.Roth ; PWS (1998).
6. "VHDL-Analysis & Modelling of Digital Systems" : Navabi Z; McGraw Hill.
7. VHDL-IV Edition: Perry; TMH (2002)
8. "Introduction to Digital Systems" : Ercegovac. Lang & Moreno; John Wiley (1999).
9. Fundamentals of Digital Logic with VHDL Design : Brown and Vranesic; TMH (2000)
10. Modern Digital Electronics- III Edition: R.P Jain; TMH (2003).
11. Grout - Digital system Design using FPGA & CPLD 'S,Elsevier

Distributed Energy Integration

Course Code	**OEC-EE-06G**		
Category	**Open Elective**		
Course title	**Distributed Energy Integration** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

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

1. To introduce the concept of distributed generation, microgrids, electric vehicles and energy storage.
2. To familiarize the students with renewable generation system modelling and their grid integration issues.
3. To impart an understanding of economics, policies and technical regulations for DG integration.

Section A

Distributed Generation

Reasons for growth, extent of DGs, Issues with DGs, Policy/institutional issues, market/financial issues, social/environmental issues, DG Plant Types, DG Machinery & its control, Integration issues, Technical impacts of DGs, Economic impact of DGs, Impact on transmission and generation systems, Security and reliability, International DG integration experience.

Wind/PV System Modelling: Wind/PV variability and uncertainty, Forecasting methods and applications.

Section-B

System studies

Power flow studies, Fault studies, Stability studies, Transient studies, Inertia and Frequency Response studies.

System balancing & imbalance handling: Flexibility Issues, Ramping issues, Inertia and Frequency Response Issues, Role of storage and DR and related issues, Large scale storage for grid stability / Backup.

Electric Vehicles

Technology, Components of EV and their modelling, Charging and Discharging Mechanisms, Driving & Plug-in pattern analysis, Scheduling issues, Challenges in EV integration, Bulk Electric Vehicles, Ancillary Services from EVs.

Section-C

Technical regulations for the interconnection of DGs to the power systems

Overview of technical regulations, Active power control, Frequency control, Voltage control, Technical solutions for new interconnection rules. Protection of DGs. Feasibility of integrating Large-Scale Grid Connected DG, Policy, Market and Regulatory Interventions, Regulatory challenges, Viability of DG integration in deregulated electricity market.

Energy Storage: Type and modelling of storage systems. Scheduling issues, Ancillary services from energy storage, Role in Energy Security, Reliability and Stability.

Section-D

Economics of DG

Value of power from DGs, Market value of power from DGs, Loss reduction, Investment reduction, Connection costs and charges, Distribution use of system charges, Allocation of losses in distribution networks with DG, Alternative framework for distribution tariff development.

DGs in areas of limited transmission capacity.DGs in distribution networks.Active Management of Distribution systems. Ancillary Services with DGs, Markets for Ancillary Services. DER Management, Virtual Power Plants.

Micro Grids

Concept, Design, Modelling, Operation and Analysis. Role in Energy Reliability, Cold Load Pick Up and Sustainability.

Reference Books:

•Math H. Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", WileyIEEE Press, 2011.

• Willis H. Lee and Scott W. G., "Distributed Power Generation Planning and Evaluation", Marcel Dekker, Inc, New York, 2000.

• B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson and D. Milborrow, "Wind Power Integration: Connection and System Operational Aspects" IET, 2007.

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

• Komarnicki, Przemyslaw, Lombardi, Pio, Styczynski, Zbigniew , "Electric Energy Storage Systems", Springer, 2017.

• Garcia-Valle, Rodrigo, Peças Lopes, João A, "Electric Vehicle Integration into Modern Power Networks", Springer, 2012.

Conventional and Renewable Energy Resources

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

Course Code	**OEC-EE-08G**		
Category	**Open Elective**		
Course title	**Conventional and Renewable Energy Resources** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

Objective:

- The course will provide understanding of power generation technology using conventional and non conventional energy sources which will be useful for understanding the operation and working of power plants.
- Students will learn basics of Tariff structure for energy production.
- Students will understand the operation, maintenance and working of substations.

Section-A

INTRODUCTION: Energy sources, their availability, recent trends in Power Generation, Amount of generation of electric power from Conventional and non conventional sources of energy in Haryana, India and some developed countries of the world. Interconnected Generation of Power Plants.

Section-B

POWER GENERATION PLANNING: Load forecasting, load curves, load duration curve, Base load and Peak load Power Plants, connected Load, maximum demand, demand factor, Group diversity factor, load factor, significance of load factor, plant factor, capacity factor, selection of unit size, No. of Units, reserves, cost of power generation, Depreciation, tariff.

Section-C

CONVENTIONAL ENERGY SOURCES: Selection of site, capacity calculations, classification, Schematic diagram and working of Thermal Power Stations(TPS), Hydro Electric Plant and Nuclear Power Plant .

NON-CONVENTIONAL ENERGY SOURCES: Selection of site, capacity calculations, Schematic diagram and working of Wind, Solar, fuel cell, Magneto Hydro Dynamic (MHD) system.

Section-D

ELECTRIC ENERGY CONSERVATION & MANAGEMENT: Energy management, Energy Audit, Energy Efficient Motors, Co-generation.

Course Outcomes:

After learning the course the students should be able to:

1. Describe the working of thermal power station using single line diagram and state the functions of the major equipment and auxiliaries of a TPS.

2. Explain hydro energy conversion process with block diagrams and identify the appropriate site for it.
3. Explain the working of Nuclear power station.
4. Describe the working of Solar Power station and wind power plant.
5. Compare various economic aspects of different types of Tariffs.
6. Classify various substations and describe working of its equipments.
7. Compare various generating systems.

REFERENCES:
1. Renewable Energy Sources and Emerging Technologies : D.P Kothari, K.C.Singla, Rakesh Ranjan- PHI Publications, 'Latest Edition'.
2.Electric Power Generation, B.R.Gupta, 'Latest Edition'.
3. Power Generation, Operation and Control, Wood and Wollenberg, John Wiley & Sons,'Latest Edition'.
4. A Course in Electric Power System, Soni, Gupta, Bhatnagar, Dhanpat Rai & Sons, 'Latest Edition'.
5. Power System Engineering, Nagrath & Kothari, Tata Mc-Graw Hill, New Delhi, 'Latest Edition'.
6. Power Plant Engg: G.D. Rai, 'Latest Edition'.
7. Electric Power: S.L. Uppal (Khanna Publishing), 'Latest Edition'.

Soft Computing

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

Course Code	**OEC-EE-10G**		
Category	**Open Elective**		
Course title	**Soft Computing** (Theory)		
Scheme	**L**	**T**	**P**
	3	-	**-**

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.

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

1. To understand the concepts of soft computing.
2. To introduce the ideas of fuzzy logic, Artificial Neural networks, genetic algorithm.
3. To introduce the concepts of hybrid intelligent systems.
4. To introduce application areas of soft computing and the criteria to select appropriate soft computing

Section A

Soft Computing: Introduction, requirement, different soft computing techniques and their characteristics, comparison with hard computing, applications.

Section B

Fuzzy sets and Fuzzy logic: Introduction, Fuzzy sets versus crisp sets, properties of fuzzy sets, operations on fuzzy sets, Extension principle, Fuzzy relations, Linguistic variables, linguistic terms, Linguistic hedges, Fuzzy reasoning, Mamdani and TSK fuzzy inference systems, Applications, fuzzy controllers, Theoretical and implementation issues.

Section C

Artificial Neural Network: Introduction, comparison with biological neural network, basic models of artificial neuron, different architectures of ANN, Learning techniques, ANN based system modeling, ANN based controller design, theoretical and implementation issues, Applications.

Section D

Evolutionary algorithms and hybrid systems: Genetic Algorithm (GA), different operators of GA, convergence of Genetic Algorithm, Particle swarm optimization algorithm, Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design, Fuzzy Logic design, other Applications of GA.

References :

1. Neuro Fuzzy & Soft Computing - J.-S.R.Jang, C.-T.Sun, E.mizutani, Pearson Education

2. Neural Networks and Fuzzy Systems: Dynamical Systems Application to Machine Intelligence - Bart Kosko, Prentice Hall

3. T.J. Ross, "Fuzzy Logic Control", TMH Publications.

4. S. Hekins, "Comprehensive Neural Networks", Pearson Publications.

5. S. Rajsekharan, VijayalaxmiPai, "Neural Networks, Fuzzy logic and Genetic Algorithms, Synthesis and applications", Prentice Hall

6. V. Kecman, "Learning and Soft Computing", MIT Press. B.Tech. (Electrical Engineering) BOS 24-05-2017

7. D. Ruan, "Intelligent Hybrid Systems", Kluwer Academic Publisher.

ORGANIZATIONAL BEHAVIOUR

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

Course Code	HSMC-02G		
Category	HS		
Course title	ORGANIZATIONAL BEHAVIOUR		
Scheme	**L**	**T**	**P**
	3	-	**-**

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 Objectives:

The objective of this course is to expose the students to basic concepts of management and provide insights necessary to understand behavioral processes at individual, team and organizational level.

COURSE OUTCOMES:

1. Students will be able to apply the managerial concepts in practical life.
2. The students will be able to understand the concept of organizational behavior at individual level and interpersonal level.
3. Students will be able to understand the behavioral dynamics in organizations.
4. Students will be able to understand the organizational culture and change.

UNIT - 1

Introduction of Management- Meaning, definitions, nature of management; Managerial levels, skills and roles in an organization; Functions of Management: Planning, Organizing, staffing, Directing & Controlling, Interrelationship of managerial functions, scope of management & Importance of management. Management and social responsibility, difference between management and administration.

UNIT - 2

Introduction of organization:-

Meaning and process of Organization, Management v/s Organization;

Fundamentals of Organizational Behavior: Concepts, evolution, importance and relationship with other Fields; Contemporary challenges and opportunities of OB.

Individual Processes and Behavior-Personality- Concept, determinants and applications; **Perception-** Concept, process and applications, **Learning**- Concept ,theories ; **Motivation-** Concept, techniques and importance.

UNIT - 3

Interpersonal Processes- **Teams and Groups**- Definition of Group, Stages of group development, Types of groups, meaning of team, merits and demerits of team; difference between team and group, **Conflict-** Concept, sources, types, management of conflict; **Leadership:** Concept, function, styles & qualities of leadership.

Communication – Meaning, process, channels of communication, importance ,barriers and overcome of communication.

UNIT - 4

Organizational Processes: Organizational structure - Meaning and types of organizational structure and their effect on human behavior; **Organizational culture -** Elements, types and factors affecting organizational culture. **Organizational change:** Concept, types & factors affecting organizational change, Resistance to Change.

REFERENCES:

1. **Robbins, S.P. and Decenzo, D.A. Fundamentals of Management, Pearson Education Asia, New Delhi.**
2. **Stoner, J et. al, Management, New Delhi, PHI, New Delhi.**
3. **Satya Raju, Management – Text & Cases, PHI, New Delhi.**
4. **Kavita Singh, Organisational Behaviour: Text and cases. New Delhi: Pearson Education.**
5. **Pareek, Udai, Understanding Organisational Behaviour, Oxford University Press, New Delhi.**
6. **Robbins, S.P. & Judge, T.A., Organisational Behaviour, Prentice Hall of India, New Delhi.**
7. **Ghuman Karminder, Aswathappa K., Management concept practice and cases, Mc Graw Hill education.**
8. **Chhabra T. N., Fundamental of Management, Sun India Publications-New Delhi.**

UNIVERSITY INSTITUTE OF ENGINEERING AND TECHNOLOGY
MAHARSHI DAYANAND UNIVERSITY, ROHTAK

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

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

Sl. No.	Course Code	Course Title	Teaching Schedule 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-1I	Program Elective -V	3	1	0	25	75	0	100	4	3
3.	Refer to Table-III	Open Elective-III	3	0	0	25	75	0	100	3	3
4.	Refer to Table-IV	Open Elective-IV	3	0	0	25	75	0	100	3	3
5.	PROJ-EE-423G	Project Stage-I	0	0	4	50	0	50	100	2	3
6.	HSMC -08G	Fundamentals of Management	2	0	0	25	75	0	100	2	2
7.	INT –EE-425G	Evaluation of Summer Internship	0	0	2	-	-	-	-	-	-
Total									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(Program Elective -IV)

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

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

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

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

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

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

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

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

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

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

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

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

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

TABLE-VII

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

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

Power Management

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

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

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

Course Outcomes:

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

- Know about the present power scenario of India.
- Know about the general layout of various engineering equipments.
- Know theoretically and practically about power utilities of Haryana.
- Know about various risks and hazards in the concern area.

SECTION-A

INTRODUCTION: Power Scenario, Power Development, Planning, Power resources, Environment Power matters Plan, Pre-feasibility and feasibility studies, State relations for Power etc.

RESOURCES: Resources, Geophysical study, Seismic Considerations, Environmental Restraints, Resettlement and Rehabilitation.

SECTION-B

PROCUREMENT: Contracting and Procurement, Consulting Services, Types of Contracts, Project Management, Organization and Economy Management, Organizational Planning and Time Scheduling, Project Cost Control.

ENGINEERING: Engineering & General Layout of Equipments, Generator, Transformer and Switch Gear and Control Equipment, Construction Methods, Operation and Maintenance Principle, Maintenance organization and planning, Availability, life cycle cost & future development. Visits to sites.

SECTION-C

POWER SECTOR: Power sector structure in different states, Regulatory Regime in those states, Power utilities in Haryana, Grid management, Power financing, Visit to sites.

POWER STATION: Management of Fuel, water Resource Electricity deviend scenario storage and handling, Pricing, Contract etc., Human resource management. Visit to sites.

SECTION-D

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

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

Text / Reference Books:

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

Electrical Engineering Drawing

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

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

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

Course Outcomes:

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

1 Understand the basic design and drawing for armature, transformer, d.c. machine, induction motor and synchronous machine and substation individually.

2 Understand the complete detailed design of all static and rotating machines and their performance with problems.

3 Understand to analyze the design procedure and performance of various algorithms.

.

Section-A

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

Section-B

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

Section-C

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

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

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

Section-D

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

Text/References:

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

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

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

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

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

Utilization of Electrical Power

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

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

Course Objectives:

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

Course Outcomes:

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

1. To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition
2. To acquaint with the different types of heating and welding techniques
3. To study the basic principles of illumination and its measurement
4. To understand the basic principle of electric traction including speed– time curves of different traction services

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

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

Power Systems Planning&Reliability

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

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

Course Objectives:

1.Understand the power system planning objectives
2.Understand the generating system planning issues.
3. Understand the load forecasting
4. Understand basic concept of reliability

Course Outcomes:

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

1. Understand the concept of power system planning.

2. Evaluate the peak demand and energy requirements of system using forecasting techniques.
3. Understand concepts of Reliability Evaluation of generation,transmission and distribution system.

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

Section-A

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

Section-B

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

Section-C

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

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

Section-D.

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

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

Text / References

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

Modeling and Analysis of Electrical Machines

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

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

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

Course Outcomes:

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

- Understand the basic principle and operation analysis of rotating machines.

Understand the complete operation of rotating machines and their performance evaluation with problems.

- Understand and analyze the various reference frame and algorithms for 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-413G		
Category	Program Elective Course		
Course title	Microcontroller Based System Design (Theory)		
Scheme	L	T	P
	3	1	-

Course Objectives:

1. To introduce the architecture of PIC microcontroller
2. To educate on use of interrupts and timers
3. To educate on the peripheral devices for data communication and transfer
4. To introduce the functional blocks of ARM processor

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

1. To understand and apply computing platform and software for engineering problems.
2. To understand ethical issues, environmental impact and acquire management skills.

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

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

Section-B

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

Section-C

UNIT III PERIPHERALS AND INTERFACING
I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter– UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

Section-D.

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

Text / References

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.
3 Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

Advanced Power Transmission

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

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

Course Objectives:

1 Understand Knowledge of Extra High Voltage AC & DC Transmission System

2 To understand and estimation of transmission line parameters.

3 To obtain the equivalent circuits of the transmission lines for determining voltage regulation and efficiency.

4 To know about the FACTS controllers.

Course Outcomes:

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

1 Discuss Modelling of the transmission line parameters.

2 Explain the equivalent circuits for the transmission lines based on distance and determine voltage regulation and efficiency.

3 To deal with the importance of HVDC Transmission and HVDC Converters

4 Knowledge of Modern power controllers to enhance the stability and capability of existing network.

5 Monitoring and improvement of Power Quality

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

Computer Aided Power System Analysis

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

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

Course Objectives:

1. Understand

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

Course Outcomes:

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

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

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

Section-A

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

Section-B

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

Section-C

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

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

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.

Intelligent Systems and Control

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

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

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

Course Outcomes:

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

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

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.

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

Section-B

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

Section-C

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

Section-D.

Transmission System Operation, Protection of Distributed Generators, Economics of Distributed Generation

Text / References

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

Intelligent Systems and Control

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

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

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

Course Outcomes:

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

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

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:

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

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

COURSE OBJECTIVES:

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

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to

be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit-I

Module-1: Traffic Characteristics: Importance of traffic characteristics. Road user characteristics. Vehicular characteristics. Max dimensions and weights of vehicles allowed in India.

Module-2: Traffic Studies: Traffic volume study, speed study and origin and destination study. Speed and delay study.

Unit-II

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

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

Unit-III

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

Unit-IV

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

COURSE OUTCOMES:

After completing this course, students should be able:

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

RECOMMENDED BOOKS:

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

Course code	OEC-ME-410G				
Category	Open Elective Courses (OEC)				
Course title	**QUALITY ENGINEERING**				
Scheme and Credits	L	T	P	**Credits**	
	3	0	0	3	
Objectives:	To understand the concept of Quality Engineering which emphasizes growth, creativity, and analytical thinking.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

Section A

Basic Concepts of Quality: Definitions of Quality and its importance in industry, Quality function, Quality Characteristics, Quality process, Quality Traits, Applications of Quality Concept,

Introduction to quality control, Computer aided quality control, Total quality control(TQC) and its implementation, Elements of TQC, Quality Circle, Objectives of quality circle, Role of management in quality circle, Quality in service organizations, characteristics of a service organization, Important service dimensions, Design of service quality.

Section B

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

Section C

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

Section D

Total Quality Management: Introduction o TQM, Concepts, Characteristics of TQM, Relevance of TQM, Approaches to TQM Implementation, TQM philosophies, Taguchi Philosphy, JIT, Kaizen, Six Sigma approach, 5-S approach

Course Outcomes: Upon completion of this course the student will be able to:

CO1 - Attain the basic techniques of quality improvement, fundamental knowledge of statistics and probability

CO2 - Use control charts to analyze for improving the process quality.

CO3 - Describe different sampling plans

CO4 - Acquire basic knowledge of total quality management

CO5 - Understand the modern quality management techniques

Text Books:

1. Quality planning and Analysis, Juran and Gryna, TMH, New Delhi
2. Quality Management, Kanishka Bed, Oxford University Press, New Delhi

3. Introduction to SQC, Montgomery DC, 3e, Wiley, New Delhi
4. Fundamentals of quality control and improvement, A Mitra, Mcmillan pub. Company, NY

Reference Books:

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

SOLAR PHOTOVOLTAIC TECHNOLOGY

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

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

Course Objectives:

On end of the syllabus or completion of the course, students will be able

1 Understand the electrical properties and Behaviour of Solar Cells.
2 To design of various PV-interconnected systems.
3 To understand about the comparison of various source applications.

Course Outcomes:

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

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

Energy Conservation and Management

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

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

Course Objectives:

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

Course Outcomes:

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

1 understand the basic knowledge of different terms & principles of energy conservation, audit and management.
2 Evaluate the energy saving & conservation in different mechanical utilities.
3 understand efficient heat & electricity utilization, saving and recovery in different thermal and electrical system.
4 prepare energy audit report for different energy conservation instances.

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

Section-A

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

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

Section-B

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

Section-C

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

Section-D.

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

Text / References

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

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

COURSE OBJECTIVES:

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

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

Unit-I

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

Unit-II

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

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

Unit -III

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

Unit IV

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

COURSE OUTCOMES:

After completing this course, students should be able:

1. To know natural as well as manmade disaster and their extent and possible effects on the economy.
2. To Plan national importance structures based upon the previous history.
3. To acquaint with government policies, acts and various organizational structures associated with an emergency.
4. To know the simple dos and don’ts in such extreme events and act accordingly.

REFERENCE BOOKS:

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

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

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

Course code	**OEC-ECE-451-G**				
Category	**Open Elective Course**				
Course title	**Electronic Principles**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

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

Course Objective:

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

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

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

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

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

TEXT BOOK : 1.Integrated Electronics: Millman & Halkias ; McGrawHill
2.Modren Digital Electronics: R.P. Jain; McGraw-Hill

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

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

Advanced Engineering Mathematics

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

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

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

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

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

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

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

Section-B

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

Section-C

Dynamic Programming and Integer Programming: Interior point methods; Karmakar's algorithm; Dual affine; Primal affine; Barrie algorithm.

Section-D

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

Text / References

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

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

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

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

Computer Communication

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

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

Learning Objectives:

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

Unit 1

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

Unit 2

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

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

Unit 3

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

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

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

Unit 4

LAN interconnecting devices: Repeater, Hubs, Switches, Bridges, Routers, Gateways.

Internet and E-mail: Concept of Internet, Advantages of Internet, Security issues in using internet. Application of Internet in various fields: Scientific, Business, Research, Sports, Medicine & Health Care, Engineering, Teaching. HTTP and FTP

Email :concept, Protocols: SMTP, POP, IMAP.

Text Book:

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

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

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

Reference Books:

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

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

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

Learning Outcomes: By the end of the course the students will be able to:

1. Independently understand basic computer network technology.

2. Understand and explain Data Communications System and its components.

3. Identify the different types of network topologies and protocols.

4. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.

5. Identify the different types of network devices and their functions within a network

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

REFERENCES:

1. Principles & Practices of Management – L.M. Prasad (Sultan Chand & Sons)
2. Management – Harold, Koontz and CyriloDonell (Mc.Graw Hill).

3. Marketing Management – S.A. Sherlikar (Himalaya Publishing House, Bombay).
4. Financial Management - I.M. Pandey (Vikas Publishing House, New Delhi)
5. Management - James A.F. Stoner &R.Edward Freeman, PHI.

Project stage-1

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

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

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

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

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

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

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

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

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

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

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

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

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

Special Electrical Machines

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

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

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

Applications of Power Electronics in Power Systems

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

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

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

Course Objectives:

1. Theoretical and practical knowledge on modern day semiconductor devices, their characteristics and control.
2. Knowledge of power conditioners and their application.
3. Working knowledge of static applications of advanced power electronics like UPS, HVDC, etc.

4. Learning Modeling and Analysis of FACTS controllers.

Course Outcomes:

1. Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non- linear devices.

2. Describe basic operation and compare performance of various power semiconductor devices, passive components and switching circuits

3. Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.

4. Formulate and analyze a power electronic design at the system level and assess the performance. 5. Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.

6. Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Text / Reference Books:

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

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

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

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

Power System Stability

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

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

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

. Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. understand about the classification of stability.
2. know power system stability problem.
3. know about synchronous machine modelling.
4. how to handle various stability and unstability problem.

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

Section-A

Power System 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

Advanced Control Systems

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

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

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

Course Objectives:

1. To provide a strong concept on the compensator design and on advanced control system analysis and design techniques

2. To analyze the behavior of discrete time systems and nonlinear control systems.

Course Outcomes:

1. Design compensators using classical techniques.

2. Analyze both linear and nonlinear system using state space methods.

3. Analyze the stability of discrete system and nonlinear system.

SECTION-A

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

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

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&Weiping Li, Applied Nonlinear Control, Prentice-Hall., NJ, 1991. C

Advances in Power Transmission & Distribution

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

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

Course Objectives:

1 Understand Knowledge of Extra High Voltage AC & DC Transmission System

2 To understand and estimation of transmission line parameters.
3 To obtain the equivalent circuits of the transmission lines for determining voltage regulation and efficiency.
4 To know about the FACTS controllers.

Course Outcomes:

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

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

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

Solar Thermal Applications

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

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

Course Objectives:

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

Course Outcomes:

Upon successful completion of the course, students will be able

1. The fundamental concepts about solar energy systems and devices are incorporated.
2. The performance of the systems along with practical case studies were done.

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

Electrical Safety and Standards

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

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

Course Objectives:

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

Course Outcomes:

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

1. Describe electrical hazards and safety equipment.
2. Analyze and apply various grounding and bonding techniques
3. Select appropriate safety method for low, medium and high voltage equipment.
4. Participate in a safety team.
5. Carry out proper maintenance of electrical equipment by understanding various standards.

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

Industrial Control

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

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

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

Course Objectives:

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

Course Outcomes:

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

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

SECTION-A

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

SECTION-B

DYNAMICAL MODELLING AND FEED BACK CONTROL

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

SECTION-C

ENHANCED CONCEPTS OF PROCESS CONTROL

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

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

SECTION-D

COMMUNICATION AND NETWORKING

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

Text / Reference Books:

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

Elements of Civil Engineering

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

COURSE OBJECTIVES:

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

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

COURSE CONTENT

Unit-I

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

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

Unit-II

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

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

Unit-III

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

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

Unit-IV

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

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

Course Outcome:

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

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

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

Course code	OEC –ME-402G				
Category	Open Elective Courses (OEC)				
Course title	**OPERATIONS RESEARCH**				
Scheme and Credits	L	T	P	**Credits**	
	3	0	0	3	
Objectives:	The aims of operation research include: solving operational questions, solving questions related to resources' operations, and solving decision-making questions. Operational research has a relation with different areas of study and it has several applications. Operation research is considered as a tool of productivity. In comparison to traditional approaches, operation research provides more extensive, quantitative, and detailed information about different issues and managers can implement their decisions based on quantitative analyses. Operation research will be a good assistance for managers in different areas.				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

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

UNIT-I

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

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

UNIT-II

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

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

UNIT-III

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

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

UNIT-IV

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

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

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

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

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

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

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

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

Text Books:

1) Operation Research – TAHA, PHI, New Delhi.
2) Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.

Reference Books :

1) Operation Research- Gupta & Sharma, National Publishers, New Delhi.
2) Quantitative Techniques- Vohra, TMH, New Delhi 8. Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
3) Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
4) Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

SOLAR ENERGY APPLIANCES

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

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

Course Objectives:

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

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

Course Outcomes:

Upon successful completion of the course, students will be able

1. The fundamental concepts about solar energy systems and devices are incorporated.
2. The performance of the systems along with practical case studies were done.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one 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,VanNostrand Reinhold Co., 2007.
7. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008

Renewable Energy Converters

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

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

Course Objectives:

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

Course Outcomes:

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

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

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

Robotics

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

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

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

Course Objectives:

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

Course Outcomes:

At the end of this course,

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

SECTION-A

Introduction – Components and Structure of Robotic System.

SECTION-B

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

SECTION-C

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

SECTION-D

Advanced control for Robot Applications.

Text / Reference Books:

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

Energy Management and Auditing

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

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

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

Course Objectives:

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

Course Outcomes:

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

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

SECTION-A

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

SECTION-B

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

SECTION-C

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

SECTION-D

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

Text / Reference Books:

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

Course code	**OEC-ECE-452-G**				
Category	**Open Elective Course**				
Course title	**INTELLIGENT INSTRUMENTATION FOR ENGINEERS**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester 7th**
	3	**0**	0	**3**	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	3 Hours				

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

Course Objective:

1. Study the basic principles of intelligent instrumentation.
2. Understand Interfacing of Instruments with computer.

3. Understand the software filters.

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

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

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

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

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

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

Project stage-1I

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

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

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

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

SEMINAR

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

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

OBJECTIVE:

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

General Proficiency

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

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

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

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

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

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

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

2 External Examiner to be appointed by the University