Study Scheme & Syllabus
(Choice Based Credit System)

For

B.TECH (EE)

(3RD to 8th Semester)

Program Code: EE-301

(Session : 2016)

DEPARTMENT OF ELECTRICAL ENGINEERING

SCHOOL OF ENGINEERING

RIMT UNIVERSITY

MANDI GOBINDGARH, PUNJAB

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SECTION 1

Vision & Mission of the University

VISION

To become one of the most preferred learning places a centre of excellence to promote and nurture future leaders who would facilitate in desired change in the society

MISSION

- To impart teaching and learning through cutting edge technologies supported by the world class infrastructure

- To empower and transform young minds into capable leaders and responsible citizens of India instilled with high ethical and moral values

SECTION 2

Vision and Mission of the Department

VISION

The Department of Electrical Engineering will provide programs of the high quality to produce world class competent engineers who can address challenges and are successfully involved in innovative research . It commits itself to impart the skills, knowledge and attitudes to create, interpret, apply and disseminate engineering to build better future for humankind.

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MISSION

- To create the environment that facilitates learning fundamentals of Electrical Engineering
- To impart the knowledge in Electrical Circuits, Power Systems electrical machines, power electronics non conventional energy
- Providing better understanding of the domain of study, including wider social issues, corporate social responsibility and ethical decision making.
- To ensure continuous interaction of the students through MOU's and collaborative research projects.

SECTION 3

About the Program

B. Tech. (Electrical Engineering) or Bachelor of Technology in Electrical Engineering is an Under-Graduate Electrical Engineering course. Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism.

Our B. Tech. Program is an Outcome Based Education model which is a 4 year, 8 Semester Full time Program with a Choice Based Credit System (CBCS) and Grading Evaluation System. B.TECH EE course is structured semester wise and includes theory and Practical to impart the students a holistic understanding of B. Tech. EE subjects. After successfully completing the course, B. Tech. Electrical Engineering job scope includes Electrical engineer, Application Engineer and many more.

SECTION 4

Program Educational Objectives, Program Outcomes and Program Specific Outcomes

Programme Education Objectives

PEO1	Establish their careers in the field of Electrical Engineering and related areas, providing innovative and effective solutions.
PEO2	To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.
PEO3	To train students with good scientific and engineering breadth so as to understand, analyze, design, and create novel products and solutions for the real-life problems
PEO4	To provide students with an academic environment aware of excellence, leadership, ethical code and guidelines, and the life-long learning needed for a successful professional career.

PROGRAMME OUTCOMES

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid

	conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO 1	Apply principles of engineering, electronics and computer science; physics, chemistry, environmental science, mathematics (including differential equations, discrete mathematics, linear algebra and complex variables) and laboratory skills for building, testing, operation and maintenance of high currents electrical systems, such as, electrical machines, power and energy systems.
PSO 2	Model, analyse, design, and realize physical systems, components or processes related to high current electrical engineering systems.

SECTION 5

Curriculum / Scheme with Examination Scheme

Semester Wise(3rd to 8th) Summary of the program: B.TECH.

(ELECTRICAL ENGINEERING)

S.no.	Semester	No. of ContactHours	Marks	Credits
1.	III	25	900	25
2.	IV	25	900	24
3.	V	28	900	23
4.	VI	23	800	20
5.	VII	22	800	21
6.	VII	24	500	17
7.	**Total**	147	4800	**130**

EXAMINATION GRADING SCHEME

Marks Percentage Range	Grade	Grade Point	Qualitative Meaning
80-100	O	10	Outstanding
70-79	A^+	9	Excellent
60-69	A	8	Very Good
55-59	B^+	7	Good
50-54	B	6	Above Average
45-49	C	5	Average
40-44	P	4	Fail
0-39	F	0	Fail
ABSENT	AB	0	Fail

Percentage Calculation: CGPA *10

THIRD SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
EM3L303	Mathematics-III	3	1	0	4	16	-	24	60	100	3
TFML303	Transformers	3	1	0	4	16	-	24	60	100	3
NASL303	Network Analysis and Synthesis	3	1	0	4	16	-	24	60	100	3
EDCL303	Electronic Devices & Circuits	3	1	0	4	16	-	24	60	100	3
EMIL303	Electrical Measurement & Instrumentation	3	1	0	4	16	-	24	60	100	3
EMIP303	Measurement & Instrumentation Lab.	0	0	2	1	-	60	-	40	100	3
EDCP303	Electronic Devices & Circuit Lab.	0	0	2	1	-	60	-	40	100	3
IPTP303	Training#	0	0	4	2	-	60	-	40	100	3
SS1P303	Soft Skill -I	0	0	2	1	-	60	-	40	100	3
Total		**15**	**5**	**10**	**25**					**900**	

#Workshop training will be imparted in the institution at the end of 2nd semester for four-week duration(Minimum 36 hrs. per week) industrial tour will also from the part of this training.

FOURTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
DCML304	DC Machines	3	1	0	4	16	-	24	60	100	3
DECL304	Digital Electronics	3	1	0	4	16	-	24	60	100	3
EEML304	Electrical Engineering Materials	3	1	0	4	16	-	24	60	100	3
LCSL304	Linear Control System	3	1	0	4	16	-	24	60	100	3
EFTL304	Electromagnetic Field Theory	3	1	0	4	16	-	24	60	100	3
EM1P304	Electrical Machine - I Lab.	0	0	2	1	-	60	-	40	100	3
CSMP304	Control System Lab.	0	0	2	1	-	60	-	40	100	3
DECP304	Digital Electronics Lab.	0	0	2	1	-	60	-	40	100	3
SS2P304	Soft Skills - II	0	0	2	1	-	60	-	40	100	3
Total		**15**	**5**	**10**	**24**					**900**	

After 4th semester, student will go for 6 Weeks Institutional / Industrial Training in which he/she should cover complete knowledge of at least one of the following software: MATLAB/LabVIEW/C/C++/Automation/AutoCAD (Electrical)/Data Analysis using Excel.

FIFTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
ASML305	Asynchronous Machines	3	1	0	4	16	-	24	60	100	3
PEDL305	Power Electronics & Drives	3	1	0	4	16	-	24	60	100	3
GEPL305	Generation and Economics of Electric Power	3	1	0	4	16	-	24	60	100	3
PECP305	Power Electronics Lab.	0	0	2	1	-	60	-	40	100	3
EECP 305	Electrical: Estimation &Costing Lab.	0	0	2	1	-	60	-	40	100	3
IPTP305	Industrial Training#	0	0	4	2	-	60	-	40	100	3
SS3P305	Soft Skills-III	0	0	2	1	-	60	-	40	100	3
Department Elective – I (Select any one)											
PPEL305	Power Plant Engineering	3	1	0	4	16	-	24	60	100	3
SASL305	Signals and Systems										
MAML305	Microprocessors and Microcontroller										
IMEL305	Instrumentation Engineering										
Open Elective – I		3	1	0	4	16	-	24	60	100	3
Total		**15**	**3**	**10**	**23**					**900**	

#Industrial training to be imparted at the end of 4th semester for six weeks

SIXTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
SYML306	Synchronous Machines	3	1	0	4	16	-	24	60	100	3
PS1L306	Power System-I (Transmission and Distribution)	3	1	0	4	16	-	24	60	100	3
EM1P306	Electrical Machines-II Lab.	0	0	2	1	-	60	-	40	100	3
PIMP306	Programming in MATLAB	0	0	2	1	-	60	-	40	100	3
SS4P306	Soft Skills-IV	0	0	2	1	-	60	-	40	100	3
Department Elective – II (Select any one)											
EPUL306	Electrical Power Utilization	3	0	0	4	16	-	24	60	100	3
EAML306	Energy Auditing & Management										
SEDL306	Substation Equipment & Design										
DCSL306	Digital Control System										
Department Elective – III (Select any one)											
EEML306	Energy Efficient Machines	3	0	0	4	16	-	24	60	100	3
VIML306	Virtual Instrumentation										
FATL306	Flexible AC Transmission System Devices										
NCEL306	Non-conventional Energy Sources										

Open Elective – II	3	0	0	4	16	-	24	60	100	3
Total	**15**	**2**	**6**	**20**					**800**	

Students will undergo 8 weeks industrial training after end semester examinations of sixth semester and present a seminar along with submission of report in 7th semester

SEVENTH SEMESTER

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
NDCL307	Non-linear and Digital Control System	3	1	0	4	16	-	24	60	100	3
PS2L307	Power System-II (Switchgear and Protection)	3	1	0	4	16	-	24	60	100	3
MIPP307	Minor Project*	0	0	4	2	-	60	-	40	100	3
SWFP307	Software Lab.	0	0	2	1	-	60	-	40	100	3
PS2P307	Power System-II Lab.	0	0	2	1	-	60	-	40	100	3
IPTP307	Industrial Training#	0	0	4	2	-	60	-	40	100	3
Department Elective – IV(Select any one)											
IAML307	Industrial Automation	3	0	0	4	16	-	24	60	100	3
SERL307	System Engineering and Reliability										
DSPL307	Digital Signal Processing										
EVTL307	EHVAC Transmission										
Open Elective – III		3	1	0	4	16	-	24	60	100	3
Total		**12**	**2**	**8**	**21**					**800**	

***** *In this semester, the candidate shall submit a Minor Project (Hardware/Software) based on area of interest in consultation with his/her supervisor. Student has to deliver the seminar associated with the same work. The same work of minor project can be extended to Major Project in the next semester.*

 # Industrial training to be imparted at the end of 6th semester for eight weeks.

EIGHT SEMESTER

Program: B. Tech

Department: Department of Electrical Engineering

Credits: 17

COURSE		Contact Hours/Week			Credit	% of Total Marks					Exam Duration (Hours)
Code	Course Title	L	T	P		CWA	LWA	MTE	ETE	Total	
PSAL308	Power System Analysis and Design	3	1	0	4	16	-	24	60	100	3
HVEL308	High Voltage Engineering	3	1	0	4	16	-	24	60	100	3
MJPP308	Major Project	3	1	0	4	16	-	24	60	100	3
PSAP308	Power System Analysis and Design Lab.	0	0	2	1	-	60	-	40	100	3
Department Elective – I (Select any one)											
EMDL308	Electrical Machine Design	3	1	0	4	16	-	24	60	100	3
HVTL308	HVDC Transmission										
FLSL308	Fuzzy Logic Systems										
NNWL308	Neural Networks										
Total		**9**	**1**	**14**	**17**					**500**	

SECTION 6

Detailed Syllabus with Course Outcomes

3RD Semester

SUBJECT TITLE: TRANSFORMERS

SUBJECT CODE: TFML-303
SEMESTER: 3rd
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

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Learning Objectives

- To aware the students about the basics of Transformer.
- To provide basic concepts of different types of Transformer connections & their applications.
- To impart knowledge of singlephase transformer, auto transformer and three phase transformers.
- To impart knowledge about analysis of different transformer connections

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Contents of Syllabus:

Sr. No	Contents
UNIT-I	**Single Phase Transformer:** Construction, working principle of operation, E.M.F. equation, phasor diagram under loaded and unloaded condition, rating of transformers, Losses in transformer, Transformer testing, open and short circuit tests, back to back test, voltage regulation and efficiency, condition for maximum efficiency, equivalent circuit, Ideal Transformer, Parallel operation of single phase transformer, applications of transformers.

UNIT-II	**Auto-Transformers:** Construction, working principle of operation, phasor diagram, saving of conductor material, Comparison of auto transformer and two winding transformer, advantages, disadvantages and applications, equivalent circuit.
UNIT-III	**Three Phase Transformer:** Three winding transformer, construction of three Phase Transformer, three phase transformer connections: Star-star connection, delta-delta connection, delta-star connection, star-delta connection, phasor groups, three phase to two phase and six phase conversion, Scott connection three phase to two phase conversion, phase shifting from primary to secondary windings, Parallel operations of three phase transformers, Harmonics and excitation phenomenon, inrush current phenomenon.
UNIT-IV	**Transformer Materials:** Different types of insulting material for transformer core, winding, insulation, need for bushings, various cooling techniques, effect of temperature on the performance of transformer.

Learning Outcomes

- After the completion of course, students will be having skills to analyze transformer connections.
- Knowledge of different types of transformer operations & applications

Recommended Books

1. P.S. Bhimbra, 'Electrical Machinery', Khanna Publishers, Delhi.
2. A.E. Fitzerald, C. Kingsley and S.D. Umans, 'Electric Machinery', Tata McGraw Hill.
3. A.S. Langsdorf, 'Theory of AC Machinery', Tata McGraw Hill.
4. AshfaqHussian, 'Electrical Machines', DhanpatRai& Company.
5. S.J. Chapman, 'Electrical Machinery Fundamentals', McGraw Hill,New York.

SUBJECT TITLE: NETWORK ANALYSIS AND SYNTHESIS
SUBJECT CODE: BTEE-2303
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	2	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam; 3 Hrs

Course Objectives

1. To aware the students about the basics of networks.
2. To provide them basic concepts of different types of network theorems and their applications.
3. To impart knowledge about different circuits, analysing and synthesizing the circuits.

Contents of Syllabus:

Sr. No	Contents
UNIT-I	**Circuits Concepts:** Independent and dependent sources, Signals and wave forms: Periodicand singularity voltages, step, ramp, impulse, doublet, loop currents and loop equations, node voltage and node equations, Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity.
UNIT-II	**Time and Frequency Domain Analysis:** Representation of basic circuits in terms of generalized frequency and their response, Laplace transform of shifted functions, transient and steady response, Time domain behaviours from poles and zeros, Convolution Theorem.
UNIT-III	**Network Synthesis:** Network functions, Impedance and admittance function, Transfer functions, Relationship between transfer and impulse response, poles & zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles & zeros, Real liability condition for impedance synthesis of RL & RC circuits, Network synthesis techniques for 2-terminal network, Foster and Causer forms.
UNIT-IV	**Filters Synthesis:** Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, π-section, terminating half section, pass bands and stop bands, Design of Constant-K, m-derived filters, Composite filters.

Recommended Books

1. John Bird, 'Electrical Circuit Theory and Technology', Newnes.
2. AbhijitChakraborty, 'Circuit Theory', DhanpatRai.
3. Chaudhury D. Roy, 'Networks & Synthesis', New Age International.
4. J.A. Edminister, 'Electric Circuits',Tata McGraw Hill.
5. T.S.K.V. Iyer, 'Circuit Theory', Tata McGraw Hill.
6. Van Valkenberg, M.E., 'Network Analysis & Synthesis', PHI Learning.

SUBJECT TITLE: ELECTRONICS DEVICES & CIRCUITS

SUBJECT CODE: EDCL-303

SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives

- To aware the students about basic electronic components.
- To update the knowledge about amplification circuits to amplify the signal.
- Various types of circuits to generate signals.
- How electronic components are specified and selected for industrial applications.

Learning Outcomes

- After the completion of the course, the students could have skills about the basic Electronic Circuits, their operational characteristics and their applications.
- Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Sr. No	Contents
UNIT-I	**Introduction**: Introduction to semiconductors theory, P type and N-Type semiconductorsdiodes, Drift current, diffusion current, Rectifiers..
UNIT-II	**Bipolar Junction Transistor:** Working action of NPN and PNP. CE, CB & CC configurations, Current components, Concept of D.C. and A.C. load line and operating point, Q point selection, bias stability, various biasing circuits- fixed bias, collector to base bias, emitter bias, voltage divider, Stability factors.
UNIT-III	**Power Amplifiers**: its classifications according to mode of operation and driving output, ClassA direct coupled with resistive load, operation of class- B power amplifier, Push-Pull Amplifiers, phase inverter. Concept of feedback in amplifiers; Positive & Negative Feedback, effect of Negative Feedback on voltage gain, input & output resistance **Oscillators:** Principle of operation of different oscillator's circuits- RC Phase Shift, WienBridge, Hartley Bridge.Colpits and Crystal oscillators

UNIT-IV	**Field Effect Transistors**: FET construction and working, P-channel and N-channel JFETs. Comparison with BJT, Characteristics of JFET, JFET parameters- AC drain resistance, trans-conductance, amplification factor, dc drain resistance. Construction, working and characteristics of MOSFET.Comparison of BJT, JFET and MOSFET.

Recommended Books

1. Boylstad&Nashelsky, 'Electronic Devices & Circuits', Prentice Hall Pub.
2. Millman&Halkias, 'Integrated Electronics',Mc-Graw Hill Pub..
3. Malvino, 'Electronic Principles', McGraw Hill Pub,
4. V.K. Mehta, 'Principles of Electronics',S. Chand.
5. Donald L. Shilling & Charles Belowl, 'Electronic Circuits', Tata McGraw Hill.

SUBJECT TITLE: ELECTRICAL MEASUREMENT & INSTRUMENTS

SUBJECT CODE: EMIL- 303

SEMESTER: 3

CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hr

Learning Objectives

- To aware the students about the basics of Measurements and Instrumentation systems.
- To impart knowledge about different instruments for electrical parameters.
- To provide them basic concepts of different types of sensors and transducers.

Learning Outcomes

- After the completion of course, students will be having skills to design, analyse and instruments.
- Gain the skill knowledge of bridges and CRO operations.

SR NO.	CONTENT
UNIT-I	**Measuring Instruments:** Introduction to measuring techniques, Necessity of measurements,block diagram of measurement system, Types of instruments, classification of standards, Fundamental Unit and Derived units. Instrument Characteristics; accuracy and precision, indications of precision, repeatability, Threshold, Sensitivity and span. Different types of errors in measurement, statistical analysis of data, arithmetic mean, deviation, average and standard deviation, probable error. Principle of operation and Constructional Features; D'Arsonval Galvanometer, Moving Coil PMMC & Moving Iron instrument (Repulsion and Attraction type), Electrodynamics instruments, Electrostatic instruments and Thermoelectric Instruments Range Extension of Voltmeter and Ammeter.
UNIT-II	**Measurement of Resistance**: Low, Medium and High resistance using Kelvin Double Bridge, Ammeter-Voltmeter method, substitution method, Wheat Stone Bridge, Loss of Charge and Megger. **Measurement of Inductance and Capacitance**: Maxwell Inductance, Hay's, Anderson and Schering Bridges, Measurement of frequency by Wein bridge method.
UNIT-III	**Oscilloscope**: Basic principle & construction of Analog CRO, sweep modes, applications in measurement of voltage, frequency (Lissajous pattern), Introduction to Dual Trace Oscilloscope, Digital Storage Oscilloscope, sampling oscilloscope. Comparison between analog and digital oscilloscope
UNIT-IV	**Transducers**: Transducer and its classifications, basic requirements of Transducer/Sensors. Displacement Transducers: LVDT, RVDT and Piezo Electric. Resistance Thermometer, Thermistors, Thermocouples and Strain Gauge Transducer: Basic principle of operation of Resistance strain gauge.

Recommended Books

1. Cooper Halfrick, 'Modern Electronic Instrumentation and Measurement Techniques', PHI.
2. A.K. Sawhney, 'Electronic Instrumentation & Measurement', DhanpatRai& Sons**.**
3. Jones & Chin, 'Electronic Instruments and Measurement'.
4. J. Toppin, 'Theory of Errors', Wessely Publishing**.**

SUBJECT TITLE: INSTRUMENTATION & MEASUREMENT LABORATORY

SUBJECT CODE: MIP -303
SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Learning Objectives

- To understand the working principle and construction of the measuring instruments and recorders.
- To measure various electrical parameters using meters and transducers.
- To calibrate the measuring devices such as meters and transducers.

Learning Outcomes

- After the completion of the course, the students could have skills about the basic measurement circuits, their operational characteristics and their applications.
- Ability to use the techniques and skills to CRO.

LIST OF EXPERIMENTS

1. Study of principle of operation of various types of electromechanical measuring instruments.
2. To measure high value of DC current and voltage using shunt and Multiplier.
3. To measure low resistance using wheat stone bridge.
4. To measure active and reactive power in 3-phase balanced load by one wattmeter method.
5. To measure the active power in 3-phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter reading.
6. To study and calibrate single phase Energy Meter.
7. Measurement of resistance using Kelvin's Bridge.
8. Measurement of self-inductance using Anderson's Bridge.
9. Measurement of capacitance using Schering Bridge.
10. Plotting of Hysteresis loop for a magnetic material using flux meter.
11. Measurement of frequency using Wein's Bridge.
12. To study the connections and use of Current and Potential transformers and to find out ratio error.
13. Determination of frequency and phase angle using CRO.
14. Measurement of unknown voltage using potentiometer.
15. To find 'Q' of an inductance coil and verify its value using Q-meter.

Note: At least ten experiments should be performed in semester.

SUBJECT TITLE: ELECTRONICS DEVICES & CIRCUIT

SUBJECT CODE: EDCP-303

SEMESTER: 3
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Duration of Exam: 3 Hrs

Learning Objectives

- To understand the Characteristics of various semiconductor devices and construction of different electronic circuits using the above devices.
- Tointroducevarietyofsourcestoobtainspecificationsofelectronicdevices&to impartknowledgeabouttechnicalreportsrelatedtobasicelectroniccircuits using correct technical vocabulary.
- Able to understand identification and selection of various electronic components.

Learning Outcomes

- Ability to understand all types of electronics devices and circuits.
- Ability to design and conduct experiments, as well as to analyze and interpret data.

LIST OF EXPERIMENTS

1. To analyse the response of Zener diode asregulator
2. To analyse the response of half wave, full wave and Bridge rectifiers.
3. To plot the input and output characteristics of CE configuration.
4. To plot the input and output characteristics of CB configuration.
5. To examine the characteristics of a Class-A amplifier.
6. To examine the characteristics of Class-B amplifier.
7. To analyse the characteristics of Class-B push-pull amplifier.
8. To analyse the characteristics of complementary symmetry amplifier.
9. To discuss the response of RC phase shift oscillator and determine frequency of oscillation.
10. To discuss the response of Hartley oscillator and determine frequency of oscillation.
11. To analyse the response of Colpitt's oscillator and determine frequency of oscillation.
12. To analyse the response of Wien Bridge oscillator and determine frequency of oscillation.
13. To study the characteristics and response of crystal oscillator.
14. To plot the characteristics of FET.
15. To plot the characteristics of MOSFET.

Note: At least ten experiments should be performed in semester.

Fourth Semester

SUBJECT TITLE: DC MACHINES

SUBJECT CODE: DCML-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives

- To understand the basic concepts of D.C machines.
- To introduce different types techniques of speed control of DC machines.
- To Study the different types of testing technique.

Learning Outcomes

- To acquire skills to understand all aspects of DC motor.
- To acquire skills to understand all aspects of DC generator.
- Ability to operate and control of DC machines.
- Skill to understand the troubleshooting in DC machines

Sr. No.	CONTENT
UNIT-I	**General Concepts of DC Machines:** Principles and construction: generator action, motor action, commutator, commutation, interpolar and compensating windings, brushes, armature core, armature windings, winding pitch, commutator pitch, commutator segments, armature reaction: de-magnetizing and cross magnetizing effects.
UNIT-II	**DC Generators:** Operation, emf equation, effect of speed upon voltage and flux, types of DC generators. Characteristics of series, shunt and compound generators, voltage regulation, Condition for maximum efficiency, applications.
UNIT-III	**DC Motors:** Operation, concept of back emf, torque equation, power developed, Characteristics of DC motors (series, shunt and compound), effect of saturation and applications.
UNIT-IV	**Starters, Speed Control and Testing:** Speed control of DC motors, Ward-

	Leonard control (Voltage control), various starting techniques for DC motors: Three-point starter, four-point starter, Electric breakings of DC shunt and series motors, Testing of DC machines: Brake test, Swinburne's test, Hopkinson's test, Retardation test, Field's test.

Recommended Books

1. P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers.
2. P.K Mukherjee and S. Chakravorty, 'Electrical Machines', DhanpatRai.
3. I.J. Nagrath and D.P. Kothari, 'Electric Machines', Tata McGraw Hill.
4. Fitzgerald Kingsley, and Stephen Umans, 'Electric Machinery', McGraw Hill.

SUBJECT TITLE: DIGITAL ELECTRONICS

SUBJECT CODE: DECL-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives

- To provide knowledge about basics of digital electronics.
- To impart knowledge about designing of digital circuits.

- Students will use schematics and symbolic algebra to represent digital gates increation of solutions to design problems

Learning Outcomes:

- An ability to understand all types of combinational & sequential digital circuits and their designing.
- Students will have skills to simplify a digital design problem as part of the systematic approach to solving a problem.

Sr. no	CONTENT
UNIT-I	**Number System and Binary Code:** Introduction, Binary, decimal, Octal, hexadecimal, BCD number system, Signed and unsigned numbers, binary operations: Addition, Subtraction. Multiplication and division.Subtractions using 1's and 2's compliment.ASCII code. Excess 3 codes and Gray code. Logic gates: OR, AND, NOT, NOR, NAND, Ex-OR gates, Basic theorems of Boolean algebra, sum of products and product of sums. Minimisation using theorems, minimisation using K-map up to 4 variables.
UNIT-II	**Combinational logic circuits:** Combinational circuit design, multiplexer, demultiplexer, encoders, decoders, adders, subtractors, code converters, parity checkers, BCD display drive, magnitudecomparators.
UNIT-III	**Sequential circuits:** Flip Flop fundamentals, different flip flop configurations: SR, JK, D, T. Edge triggered and clocked flip flops, Registers: Types of Registers, series and parallel shift: circuit diagram, timing wave form and operations. Counters: synchronous and asynchronous, Johnsoncounter.
UNIT-IV	**D/A and A/D Converters:** Introduction, Weighted register D/A converter, binary ladder D/A converter, D/A accuracy and resolution, parallel A/D converter, Counter type A/D converter, Successive approximation A/D converter, Single and dual slope A/D converter, A/D accuracy and resolution.

Recommended Books

1. R.P. Jain, 'Modern Digital Electronics', Tata McGraw Hill, **2011.**
2. Malvino& Leach, 'Digital Principals & Applications', 4thEdn.,Tata McGraw Hill, **1991.**
3. Fletcher, 'An Engg. Approach to Digital Design', PHI, Indian Edn.,**2011.**
4. Sanjay Sharma, 'Digital Electronics' Kataria Sons,**2011.**

SUBJECT TITLE: ELECTRICAL ENGINEERING MATERIALS

SUBJECT CODE: EEML-304

SEMESTER: 4

CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives

1. To provide knowledge about basics of materials.
2. To impart knowledge about electricity generation using variety of materials.
3. Students will obtain skills of application of materials in daily life.

Learning Outcomes

4. An ability to understand all types of magnetic and conduction materials.
5. Students will have skills to simplify a method for power generation using cells.

UNIT-I

Elementary Materials Science Concepts: Bonding and types of solids and its defects, resistivity, factors affecting resistivity, temperature dependence of resistivity, Skin Effect, Hall Effect.

UNIT-II

Dielectric Properties of Insulators in Static and Alternating Field: Dielectric constant of gases, molecules and solids, internal field in solids and liquids, Properties of ferro-electric materials, polarization, types of polarizations, polarizability: atomic and molecular, frequency dependence of electronic and ionic polarizability, piezoelectricity and dielectric losses.

UNIT-III

Magnetic Properties and Superconductivity: Magnetization of matter, magnetic material classification, ferromagnetic origin, Curie-Weiss law, soft and hard magnetic materials, Superconductivity and its origin, critical temperature, critical magnetic field, zero resistance and Meissner Effect, Type-I and Type-II superconductors, applications of superconductors.

UNIT- IV

Conductivity of Metals: Drift velocity, relaxation time of electrons, collision time and mean free path, electron scattering and resistivity of metals.

Semiconductor Materials: Classification of semiconductors, semiconductor conductivity, temperature dependence, Carrier density and energy gap, fermi level, applications of semiconductors in electrical engineering.

Recommended Books

1. S.P. Seth, 'A Course in Electrical Engineering Materials', Dhanpat Rai and SonsPublication, 2001.
2. 'Electrical Engineering Materials', T.T.T.I, Madras,1998.
3. K.B. Raina& S.K. Bhattacharya, 'Electrical Engineering Materials', S.K. Kataria& Sons, 2004.
4. P.K. Palanisamy, 'Material Science for Electrical Engineering', SciTech Pub. (India) Pvt.Ltd., Chennai, 2011.

SUBJECT TITLE: LINEAR CONTROL SYSTEM

SUBJECT CODE: LCSL-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

I

nternal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives

6. To obtain transfer functions for electrical circuits, translational/rotational mechanical systems and electromechanical systems.
7. To learn basic goals of control systems in terms of transient/steady state time response behaviour.
8. To update the knowledge about control components.

Course Outcomes

9. After the completion of the course, the students could have skills about the basics to model the control systems.
10. Ability to analyse the stability of designed systems.

UNIT-I

Introductory Concepts: Plant, Systems, Servomechanism, regulating systems, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, Block diagrams, some illustrative examples.

UNIT-II

Modelling: Force voltage analogy, force current analogy, Transfer function, Block diagram reduction technique, signal flow graphs and Mason's gain formula, characteristics equation. **Time Domain Analysis**: Transient response of the first and second order systems, Time domain specifications, Steady state error and coefficients, Absolute and relative stability, Routh-Hurwitz Criterion.

UNIT-III

Stability Analysis: Root locus technique, sketch of the root locus plot, Frequency domain analysis: Closed loop frequency response, bode plots, relative stability using bode plot. Frequency response specifications, relation between time and frequency response for second order systems.Nyquist criterion for stability.

UNIT-IV

State Space Analysis: State space representations, transfer function from state model, state transition matrix, controllability, observability. Control components: Error detectors- potentiometers and synchro's, servo motors, A.C. and D.C. techno generators, Magnetic amplifiers.

Recommended Books

1. Dorf Richard C. and Bishop Robert H., 'Modern Control System', Addison–Wesley,Pearson New Delhi,**2009.**
2. K. Ogata, 'Modern Control Engineering', Prentice Hall,**2011.**
3. B.C. Kuo, 'Automatic Control System', Prentice Hall,**1999.**
4. I.J. Nagrath and M. Gopal, 'Control System Engineering', Wiley Eastern Ltd., **1997.**
5. B.S. Manke, 'Linear Control Systems', **2002.**

SUBJECT TITLE: ELECTROMAGNETIC FIELD THEORY

SUBJECT CODE: EFTL-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives

1.To provide knowledge about the propagation of electromagnetic wave along different mediums like guided, unguided Medias and in space with basic understanding of transmission lines and the method of solving different problems related to it.
2. Study of physical concept and all the important fundamental parameters of transmission lines and waveguides.

Learning Outcome

1. After the completion of the course, the students will be familiar with the concepts of electromagnetic field theory and fundamental equations fields.
2.The students will have skills to identify, formulates, and solves engineering problems

UNIT-I

Review of Electrostatic and Magnetostatics Fields: Review of vector algebra, Review of Cartesian, Cylindrical and spherical coordinate systems, Introduction to del operator, Use of del operator as gradient, divergence, curl. Introduction to coulomb's law, Gaussian law.Laplace's and Poission's equation in various coordinate systems.Introduction to Ampere's law, Magnetic vector potential.

UNIT-II

Time Varying Fields and Maxwell's Equations: Equation of continuity, Inconsistency of Ampere's law for time varying fields, Concept of displacement current, Maxwell's equation in integral and differential form (for static fields, time varying fields, free space, good conductors, harmonically varying fields), Poynting theorem.

UNIT-III

Uniform Plane Waves: Introduction, Uniform plane wave propagation, Wave equations: Wave equations for free space, Wave equations for conductors. Transverse nature of uniform plane waves, Reflection of electromagnetic waves by

perfect conductor andperfect dielectric, wave impedance and propagation constant, depth of penetration, surface impedance.

UNIT-IV

Wave Guides: Introduction, simple waveguides between two infinite and parallel conducting plates, Transverse Electric (TE) Waves or H-Waves, Transverse magnetic (TM) Waves or E-Waves, Characteristics of TE and TM waves, Transverse Electromagnetic (TEM) waves and its characteristics.

Recommended Books

1. Jordan and Balmain, 'Electromagnetic Wave', PHI and Radiation System, 2010.
2. Kraus, 'Electromagnetics', Tata McGraw Hill,2003.
3. W.H. Hayt and J.A. Buck, 'Problem and Solutions in Electromagnetics', Tata McGrawHill, 1999.
4. W.H. Hayt, 'Engineering Electromagnetics', T.M.H., 2012.

SUBJECT TITLE: ELECTRICAL MACHINE-I

SUBJECT CODE: EM1P-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Learning Objectives

1. To understand the basics of D.C Machines.
2. To introduce variety of speed control of dc shunt motor.
3. To Study the universal motor.

Learning Outcomes

1. To acquire skills to understand all types of dc machines.
2. Ability to analyse the speed control of machine.

LIST OF EXPERIMENTS

1. To study various components/cut-section of DC machine
2. To perform starting techniques of various DC machines.
3. To obtain torque and speed characteristics of a D.C. Shunt motor
4. To obtain external characteristics of a D.C. shunt generator
5. To obtain external characteristics of a D.C. series generator.
6. To obtain external characteristics of DC compound generator.
7. Speed control of a dc shunt motor by varying armature circuit and field circuit method
8. To obtain performance characteristics of universal motor.
9. To perform Swinburne's Test
10. To perform Hopkinson's Test
11. To perform the Brake Load Test
12. Calculate the power rating of DC machines.
13. To determine losses and efficiency of DC machines

SUBJECT TITLE: CONTROL SYSTEM

SUBJECT CODE: CSMP-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Learning Objectives

1. To understand the basics of MATLAB software.
2. To introduce variety of control system strategies.
3. To comment about t he stability of designed systems.

Learning Outcomes

1. To acquire skills to understand all types of control components
2. Ability to analyse the stability of control systems

LIST OF EXPERIMENTS

1. Familiarization with MATLAB control system toolbox, MATLAB Simulink toolbox and PSPICE.
2. Determination of step response for first order and second order system with unity feedback and their display on CRO. Calculation and verification of time constant, peak overshoot, setting time etc. from the response.
3. Simulation of step response and impulseresponsefortype-0, type-1and type-2 systems with unity feedback using MATLAB and PSPICE.
4. Determination of Root Locus, Bode-Plot, Nyquist Plot using MATLAB-Control system toolbox for 2^{nd} order system. Determination of different control system performance indices from the plots.
5. Experimental determination of approximate transfer function from Bode plot.
6. Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin, with addition of lead compensator and by compensator in forward path transfer function for unity feedback control system using PSPICE.
7. Design of a second order linear time invariant control system and study of system response with unit step input.
8. To study the characteristics of potentiometers and to use 2-potentiometers as an error detector in a control system.
9. To study the synchro Transmitter-Receiver set and to use it as an error detector.
10. To study the Speed-Torque characteristics of an AC Servo Motor and to explore its applications.
11. To study the Speed-Torque characteristics of a DC Servo Motor and explore its applications.
12. To study various electro-mechanical transducers i.e. resistive, capacitive and

inductive transducers.

13. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop system.
14. To study the operation of a position sensor and study the conversion of position in to corresponding voltage

Note:-At least ten experiments should be performed in a semester

SUBJECT TITLE: DIGITAL ELECTRONICS

SUBJECT CODE: DECP-304

SEMESTER: 4
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Learning objectives

1. To give students a practical knowledge about all types of digital circuits.
2. To give students a working knowledge to connect digital circuits and verify their truth tables.
3. To give students acknowledge about integrated circuits of different combinational and sequential circuits.

Learning Outcomes

1. Anabilitytotestandverifyworkingandtruthtablesofcombinationalandsequentialcircuits
2. Working knowledge to study input output wave forms on digital storage oscilloscope
3. Understand and commit to professional, ethics, responsibilities and norms of engineering practice.

LIST OF EXPERIMENTS

1. To Study Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates and realization of OR, AND, NOT and XOR functions using universal gates.
2. To design Half Adder using Logic gates on breadboard.
3. To design Full Adder using Logic gates on breadboard.
4. To design Half Subtractor using Logic gates on breadboard.
5. To design Full Subtractor using Logic gates on breadboard.
6. To design 4-Bit Binary-to-Gray Code Converter on breadboard.
7. To design 4-Bit Gray-to-Binary Code Converter on breadboard.
8. To study and design 4-Bit magnitude comparator using logic gates on breadboard.
9. Design and verification of Truth-table of multiplexer.
10. Realization of Half adder and Full adder using MUX.
11. Design and verification of Truth-table of Demultiplexer.
12. Realization of half subtractor and full subtractor usingDEMUX.
13. To study and verify Truth-table of RS, JK, D, JK Master Slave FlipFlops.
14. To design MOD-7 Synchronous up-counter using JK/RS/D FlipFlops.
15. To Study different shift registers: SIPO, SISO, PIPO, andPISO.
16. To Study digital logic families.

Note:-At-least ten experiments should be performed.

5TH Semester

SUBJECT TITLE: ASYNCHRONOUS MACHINES

SUBJECT CODE: ASML-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

- To impart knowledge of the constructional features and principle of operation of three-phase and single-phase induction machines.
- To impart knowledge about methods of starting and speed control of induction motors.
- To make the students aware about construction, principle of operation and applications of special purpose motors.

Learning Outcomes:

- The students will be having skills to analyse the performance of the asynchronous machines using the phasor diagrams and equivalent circuits.
- To gain knowledge of speed control and testing of asynchronous machines.
- To gain the knowledge to select appropriate asynchronous machine for any application and appraise its significance.

UNIT-I

Three Phase Induction Motors: Constructional features, Production of rotating field in space distributed three-phase winding, Principle of operation, Concept of slip, rotor frequency, current, torque and power output, Types of induction motors, Analogy between induction motor and transformer, no load and blocked rotor test, Circle diagram, Equivalent circuit parameters, Phasor diagram, Torque-slip characteristics, Effect of rotor circuit resistance, Crawling and Cogging, Cage motors (double cage and deep bar motor).

UNIT-II

Starting Methods and Speed Control: Starting methods of squirrel cage and slip ring induction motor, Different speed control methods, effect of voltage injection in rotor circuit of slip ring induction motor.

Induction Generator: Isolated and Grid mode operation, method of excitation, performance characteristics of three-phase self-excited induction generator, introduction to doubly fed induction generator.

UNIT-III

Single Phase Motors: Introduction, Double revolving field theory, types of single phasemotors (Split phase, capacitor start, capacitor run, capacitor start and run) and their characteristics, shaded pole motor: working principle and characteristics. Reluctance motor: construction, principle of operation and applications.

UNIT-IV

Special Purpose Motors: Stepper Motor: construction, principle of operation and applications. Linear Induction Motor: construction, principle of operation and applications. Universal Motor: construction, principle of operation and applications.

Recommended Books

1. E.H. Langsdorff, 'Principles of A.C. Machines', McGraw Hill, 2010.
2. I.J. Nagrath and D.P. Kothari, 'Electrical Machines', 4thEdn.,Tata McGraw Hill, 2011.
3. P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 1999.
4. M.G. Say,' Alternating Current Machines', 5th Edn., Sir Isaac Pitman and Sons Ltd., 2004.

SUBJECT TITLE: POWER ELECTRONICS AND DRIVES

SUBJECT CODE: PEDL-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To make the students aware about the power electronic devices and construction, operation and characteristics of most popular member of thyristor family i.e. SCR.
2. To acquaint them with basic concepts of operation of different types of convertors.
3. To impart knowledge about application of converters to motor drives.

Learning Outcomes:

1. The students will learn the operation and characteristics of power electronic devices
2. The students will be able to analyse operation of diffferent types of converter circuits such as; AC-DC, DC-DC, AC-AC and DC-AC.
3. The students will be able to understand application of converters for control of motor drives.

UNIT-I (14 Hrs.)

Introduction: Thyristor family and SCR, Constructional features of SCR, its static and dynamic characteristics, turn-on and turn-off methods and firing circuits, Ratings and protection of SCR'S, series and parallel operation, commutation circuits.

UNIT-II (12 Hrs.)

Phase Controlled Converters: Principle of phase control, single phase and three phaseconverter circuits with different types of loads, dual converters and their operation.

DC Choppers: Principle of chopper operation, control strategies, types of choppers, step upand step down choppers, voltage, current and load-commutated choppers.

UNIT-III (14 Hrs.)

Inverters: Single phase Voltage source bridge inverters, Modified Mc-Murray half bridge inverter, series inverters, three phase bridge inverters with 180^0 and 120^0 modes. Single phase PWM inverters, Current source inverters.

AC Voltage Controllers: Types of single-phase voltage controllers, single-phase voltagecontroller with R and RL type of loads.

Cycloconverters: Principle of operation, single phase to single phase step up and step down Cycloconverters, three phase to single phase cyclo converters.

UNIT-IV (08 Hrs.)

DC Motor Drives: DC motor drive–starting, braking, transient analysis, speed control,controlled rectifier converters for DC drives and chopper fed DC drives.

AC Motor Drives Induction motor drive–starting, braking, transient analysis, speed control, ac controller fed induction motor, voltage source inverter, current source inverter and cyclo-converter fed induction motor drive.

Recommended Books

1. G.K. Dubey, S.R. Doradla, A. Joshi, R.N.K. Sinha, 'Thyristorised Power Controllers', New Age International (P) Limited, Publishers, 2004.
2. M. Rashid, 'Power Electronics', Prentice Hall of India Private Ltd., 2006.
3. P.S. Bimbhra, 'Power Electronics', Khanna Publishers, 2004.
4. Bimal Bose, 'Power Electronics and Motor Drives', Academic Press, 2006.
5. P.C. Sen, 'Power Electronics', Tata McGraw Hill Company Ltd., New Delhi, 1992.
6. C. Rai Harish, 'Power Electronics and Industrial Applications', 1stEdn.,CBS Publishers& Distributors Pvt Ltd., 2018.

SUBJECT TITLE: GENERATION AND ECONOMICS OF ELECTRIC POWER

SUBJECT CODE: GEPEDL-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To familiarize the students with different types of loads and load curves.
2. To apprise them with different types of costs involved in power plant and tariffs imposed on the electricity consumers
3. To impart knowledge about selection and economic operation of steam plants.
4. To impart knowledge about hydrothermal coordination.

Course Outcomes:

1. Students will get knowledge of different types of loads and related terminology.
2. They will learn about various costs involved in the power plants and tariffs imposed on different categories of consumers.
3. They will gain the knowledge about co-ordinated operation of Hydro and Steam power plants.

UNIT-I (10 Hrs.)

Loads and Load Curves: Types of load (fixed voltage loads, resistive loads, Inductivemotor loads, mechanical load), effect of load on supply voltage, maximum demand, group diversity factor, peak diversity factor, types of load, chronological load curves, load-duration curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

UNIT-II (12 Hrs.)

Power Plant Economics: Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation, tariffs and power factor improvement, objectives of tariff making, different types of tariff (domestic, commercial, agricultural and industrial loads). Need for power factor improvement, power factor improvement using capacitors, determination of economic power factor.

UNIT-III (14 Hrs.)

Selection of Plant: Plant location, plant size, number and size of units in plants, economic comparison of alternatives based on annual cost, rate of return, present worth and capitalized cost methods. Economic operation of steam plants, methods of loading turbo-generators, input- output curve, heat rate, incremental cost, method of Lagrangian multiplier, effect of transmission losses, co-ordination equations, and iterative procedure to solve co-ordination equations.

UNIT-IV (12 Hrs.)

Hydro-Thermal Co-ordination: Advantages of combined working of Run-off River plantand steam plant, reservoir hydro plants and thermal plants, long-term operational aspects, scheduling methods. Cogeneration: Definition and scope, Topping and Bottoming Cycles, Benefits, cogeneration technologies.

Recommended Books

1. M.V. Deshpande, 'Power Plant Engineering', Tata McGraw Hill, 2004.
2. M.M. EI-Wakit, 'Power Plant Engineering', McGraw Hill, USA, 2010.
3. D.P. Kothari and I.J. Nagrath, 'Power System Engineering', Tata McGraw Hill, 2008.
4. S.C. Arora and S. Dom Kundwar, 'A Course in Power Plant Engineering', 6thRevisedEdn.,DhanpatRai,2011-12.

4. P.K. Nag, 'Power Plant Engineering', Tata McGraw Hill, 2014.
5. B.R. Gupta, 'Generation of Electrical Energy', S. Chand, 2017.

SUBJECT TITLE: POWER ELECTRONICS LAB

SUBJECT CODE: PECP-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Course Objectives:

1. To obtain the characteristics of SCR and UJT and to obtain triggering pulses for them.
2. To verify the performance of various converter circuits by measuring the currents and voltages at different points in the circuit and to display their waveforms.
3. To control speed of motors by using thyristors.

Course Outcomes:

1. Students will be able to verify the characteristics of SCR and UJT and triggering pulses for them.
2. They will be able to visualize and analyse the performance of various converter circuits.
3. They will be able to control the speed of motors using thyristors.

EXPERIMENTS

1. To obtain V-I characteristics of SCR and measure latching and holding currents.
2. To plot V-I Characteristics of UJT.
3. To obtain triggering wave forms for SCR using R and RC firing circuits.
4. To obtain output voltage waveforms of single phase half wave controlled rectifier for R-L load.
5. To obtain output voltage wave forms for single phase full-wave controlled rectifiers with resistive and inductive loads.
6. To simulate three phase bridge rectifier and draw load voltage and load current waveform for resistive and inductive loads.
7. To study different types of chopper circuits and obtain waveforms for at least one of them.
8. To simulate single phase inverter using different modulation techniques and obtain load voltage and load current waveform for different types of loads.
9. To simulate single phase full wave ac voltage controller and draw load voltage and load current waveforms for inductive load.
10. To study single phase cycloconverter.

11. To study speed control of induction motor using thyristor.
12. To study speed control of DC motor using thyristor.

Note: At least ten experiments should be performed in the semester.

Recommended Books

1. K.R. Varmah, K. John Ginnes, Abraham Chikku, 'Power Electronics, Design, Testing and Simulation, Laboratory Manual', 1stEdn.,CBS Publishers & Distributors Pvt. Ltd., 2017.
2. O.P. Arora, 'Power Electronics Laboratory, Theory, Practice and Organization', Narosa Publishing House, 2007.

SUBJECT TITLE: ELECTRICAL ESTIMATION AND COSTING LAB

SUBJECT CODE: EECP-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

EXPERIMENTS

1. To study Indian electricity act 2003.
2. To carry out wiring diagram of residential building/educational institute/industry.
3. To study design parameters of electrical panel boards.
4. To estimate the cost of a domestic installation (Residential building/laboratory/drawing hall) with concept of illumination design.
5. To estimate the cost of industrial installation.
6. To estimate the cost of overhead service connection.
7. To estimate the cost of underground service connection.
8. To estimate the load and cost of any five electrical appliances.
9. To estimate the cost of repair and maintenance of any five domestic appliances.
10. To study various types of light sources and lighting schemes.
11. To draw wiring diagrams of motor control circuits for starting of induction and synchronous motors.
12. To carryout electrical energy audit of laboratory/office/workshop.

Note: At least ten experiments should be performed in semester.

SUBJECT TITLE: SOFT SKILLS-III

SUBJECT CODE: SS3P-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Course Objectives:

The course aims to equip the students with effective writing skills in English. Also, to make the students understand their role as team players in organizations.

Course Outcomes

At the completion of the course, the student will become well –versed with the behavioural skills. They will also understand the role of body language and non-verbal communication during the interview process.

UNIT-1

ART OF WRITING - Introduction, Importance of Writing Creative Writing, Writing tips, Drawback of written communication.

Art of Business Writing: Introduction, Business Writing, Business Letter, Format and Styles, Types of business letters, Art of writing correct and precise mails, Understand netiquette.

UNIT-2

Body Language: Introduction- Body Talk, Forms of body language, uses of body language, Body language in understanding Intra and Inter-Personal Relations, Types of body language, Gender differences, Gaining confidence with knowledge of Kinesics.

UNIT-3

Team Building and Team Work: Introduction, Meaning, Characteristics of an effective team, Role of a Team Leader, Role of Team Members, inter group Collaboration-Advantages, Difficulties faced, Group Exercises-Team Tasks and Role-Play, Importance of Group Dynamics.

UNIT-4

Time Management: Introduction, the 80-20 Rule, three secrets of Time Management, Time Management Matrix, Effective Scheduling, Time Wasters, Time Savers, Time Circle Planner, Difficulties in Time Management, Overcoming Procastination.

Recommended Books

1. K. Alex, S. Chand Publishers.
2. R.C. Sharma and Krishna Mohan, 'Business Correspondence and Report Writing', TMH,New Delhi, 2016.
3. N. Krishnaswami and T. Sriraman, 'Creative English for Communication', Macmillan.
4. Penrose, John M., et al., 'Business Communication for Managers', Thomson SouthWestern, New Delhi, 2007.
5. Holtz, Shel, 'Corporate Conversations', PHI, New Delhi, 2007.

SUBJECT TITLE: POWER PLANT ENGINEERING

SUBJECT CODE: PPEL-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To introduce the students to the classification of steam and hydro-electric power plants and make them familiar with the main equipment and machinery used in them.
2. To provide them basic concepts of nuclear, gas and diesel power plants.
3. To impart knowledge about pollution control and combined operation of different plants.

Course Outcomes:

1. The students will acquire knowledge about various equipment used in thermal, hydro and nuclear power generation.
2. They will also become familiar with equipment used in gas and diesel power plants.
3. They will come to know about the importance of co-ordinated operation of different power plants and methods of pollution control.

UNIT-I (14 Hrs.)

Steam Generators, Condensers and Turbines: Classification of steam generators, Types of condensers, effect of air in condensers, steam nozzles, types of steam turbine efficiencies. **Steam Power Plant:** Classification, Operation, Description of Rankin cycle, coal handling system, combustion system, Ash handling, Feed pumps, Heat exchangers, Economizers, Super heaters, Reheaters, Air preheaters, Feed water heaters, Evaporators.

UNIT-II (10 Hrs.)

Hydro-Electric Power Plants: Hydrological cycle, Hydrograph, Flow duration curve, Classification of hydro plants, Selection of water turbines for hydro power plant.

Nuclear Power Plants: Nuclear physics, Binding energy, Radioactive decay. Fertile material, Mass defect, Nuclear reactions type and application, Generation of nuclear energy by fission, Nuclear reactors. Safety measures, Future of nuclear power.

UNIT-III (8 Hrs.)

Gas Turbine: Elements of gas turbines, Open and closed cycles for gas turbines, Performance terms, Plant layout, applications.

Diesel Power Plants: Classifications of IC Engines and their performance, four stroke and two stroke diesel engines, combustion phenomenon; Essential components, Cetane number, knocking, super charging, operation and layout of diesel power plant.

UNIT-IV (8 Hrs.)

Combined Operation of Different Power Plants: Advantages of combined operation of plants, load division between power stations, coordination of different types of Power Plants.

Pollution Control: Pollution from thermal and nuclear plants, Particulate emission and control, electrostatic precipitator, solid waste disposal.

Recommended Books

1. Chakrabarti, Soni, Gupta and Bhatanagar, 'A Textbook on Power System Engineering', DhanpatRai& Co., 2013.
2. M.M. EI-Wakil, 'Power Plant Technology', 2nd Reprint, Tata McGraw Hill Edn.,2010.
3. R.K. Rajput, 'Power Plant Engineering', 4thEdn.,Luxmi Publications, 2010.
4. P.C. Sharma, 'Power Plant Engineering', Kataria and Sons, 2009.
5. B.G.A. Skrotzki and W.A. Vapot, 'Power Station Engineering and Economy', 31st Reprint, Tata McGraw Hill Education Pvt. Ltd., 2009.
6. P.K. Nag, 'Power Plant Engineering', 4thEdn.,McGraw Hill Education (India) Pvt. Ltd.,2014.

SUBJECT TITLE: SIGNALS AND SYSTEMS

SUBJECT CODE: SASL-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To understand the classification of signals.
2. To apply Fourier series and Fourier Transformation to periodic and aperiodic signals.
3. To introduce the concepts of probability of occurrence of random events.
4. To understand different types of noise associated with signals.

Course Outcomes:

1. The students will learn about various types of signals and systems.
2. They will be able to analyse these signals using Fourier series and transform.
3. The students will learn to analyse various types of noise in the system.

UNIT-I (10 Hrs.)

Introduction: Classification of Signals and Systems, Linear time invariant systems, Convolution, Representation of signals in terms of impulses, Signal Representation using Fourier Series, Complex and Exponential Fourier Series, Fourier Series Representation of Periodic Signals, Properties of Fourier series, Parseval's theorem.

UNIT-II (10 Hrs.)

Signal Analysis: A periodic Signal Representation using Fourier Transforms, Fourier Transforms of Periodic Power Signals, Signal Transmission through Linear Networks, Convolution Theorem and its graphical interpretation, Sampling Theorem, Correlation, Autocorrelation.

UNIT-III (10 Hrs.)

Probability: Introduction to Probability Theory, Definition of Probability of Random Events, Joint and Conditional Probability, Cumulative Distribution Function (CDF), Probability Density Functions (PDF) and Statistical Averages of random variables, introduction to random processes.

UNIT-IV (10 Hrs.)

Noise: Thermal Noise, Shot noise, Partition noise, Flicker noise, Gaussian Noise, Noise in Bipolar Junction Transistors (BJTs), FET noise, Equivalent input noise, Signal to Noise Ratio (SNR), Noise Temperature, Noise equivalent Bandwidth, Noise Figure, Experimental determination of Noise Figure.

Recommended Books

1. V. Oppenheim Alan, 'Signals and Systems', Prentice Hall, 1997.
2. S. Haykins and B.V. Veen, 'Signals and Systems', John Wiley and Sons, 2007.
3. M.J. Roberts, 'Fundamentals of Signals and Systems', SIE Edn.,McGraw HillEducation, 2007.
4. B.P. Lathi, 'Linear Systems and Signals', Oxford University Press, 2009.
5. Sanjay Sharma, 'Signals and Systems', Katson Publishers, 2013.
6. Rajeswari K. Raja, Rao B. Visvesvara, 'Signals and Systems', PHI Learning Pvt. Ltd., 2014.
7. M. Nahvi, 'Signals and Systems', McGraw Hill Education, 2015.

SUBJECT TITLE: MICROPROCESSORS AND MICROCONTROLLERS

SUBJECT CODE: MAML-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To acquire detailed knowledge about architecture and operation of 8085 microprocessor
2. To study 8051 microcontrollers in detail.
3. To interface peripheral devices with microprocessors and microcontrollers.

Course Outcomes:

1. The students will learn about architecture, operation, instruction set and programming of 8085 microprocessors.
2. The students will learn about architecture, operation, instruction set and programming of 8051 microcontrollers.
3. Students will learn how to interface 8085 and 8051 with peripheral devices

UNIT-I (10 Hrs.)

History and Evolution: Background history of Microprocessors, Introduction to Basic features, General Architecture of Microprocessors, Recent trends and Applications. **8085 Microprocessor:** Architectural Block Diagram, Schematic and Pin diagrams, Pin functions, Bus Organization, Internal operations and registers, externally initiated operations, Timing and Control Unit, Microprocessor communication, Multiplexing of address/data bus, Generation of control signals, 8085 machine cycles, Timing Diagrams Addressing Modes, Instruction Set, Interrupts, Programming Examples, Direct Memory Access. Peripheral Controllers: USART (8251), RS-232C, Programmable Peripheral Interface (8255), Programmable Interrupt Controller (8259) and their applications.

UNIT-II (13 Hrs.)

8051 Microcontroller Architecture: Introduction to MCS -51 Family microcontrollers, Architectural block Diagram, Pin diagram and Pin Functions, General Purpose and Special Function Registers, Oscillator and clock circuit, Reset circuit, I/O Port circuits, Memory organization, Internal program and data memory.

Introduction to Program Development Tools (IDE): Concept of IDE, Editor, Assembler, Compiler, Linker, Simulator, Debugger and assembler directives.

8051 Assembly language programming: Programming model of 8051, Addressing modes, data transfer instructions, I/O Port programming, Arithmetic and Logical instructions, Bit level instructions, Branching instructions (Jump and loop Jump and call), Concept of stack, subroutine and related instructions, writing programs (like time delay using loop, data conversions HEX to ASCII, BCD to ASCII, use of look up table etc.) in assembly language 8051 and testing the same using IDE.

UNIT-III (10 Hrs.)

External Memory Interfacing: Memory address decoding, interfacing 8031/8051 with ROM/EPROM and Data ROM.

8051 Timer/Counter and Programming: Use of counter as timer, Timer/Counters and associated registers, Various modes of timer/counter operations, Time delay programs in Assembly language/ Embedded C.

8051 Serial Port and Programming: Basics of serial communication, RS232 standards,8051 connections to RS232, Serial data input/output and associated registers, Various modes of serial data communication, serial data communication programs in Assembly language/ Embedded C.

8051 Interrupts: Concept of Interrupt, interrupt versus polling, Types of interrupts in 8051,Reset, interrupt control and associated registers, interrupt vectors, Interrupt execution, RETI instruction, software generated interrupt, interrupt handler subroutine for timer/counter and serial data transmission/reception in Assembly language/ Embedded C.

UNIT-IV (7 Hrs.)

Applications and design of microcontroller based systems: Interfacing of LEDs, 7Segment display device, LCD display, DIP Switches, Push Button switches, Key debounce techniques, Keyboard connections, load per key and matrix form, Interfacing A/D converter, D/A converter, Relay, Opto-isolator, stepper motor and DC motor

Recommended Books

1. R.S. Gaonkar, 'The 8085 Microprocessor- Architecture, Programming and Interfacing', Penram International Publishing (India) Pvt. Ltd. 6thEdn.,2013.
2. D.V. Hall, S.S.S.P. Rao, 'Microprocessors and Interfacing', 3rdEdn.,McGraw-HillEducation, 2012.
3. M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, 'The 8051 Microcontroller and Embedded Systems: using Assembly and C', Pearson Education, 2007.
4. Sunil Mathur, 'Microprocessor 8085 & its Interfacing', 2nd Edn., Prentice Hall of India, 2011.
5. MandalSoumitra Kumar, 'Microprocessors and Microcontrollers: Architecture, Programming and Interfacing Using 8085, 8086 and 8051', McGraw Hill Education, 2017.
6. B. Ram, 'Fundamentals of Microprocessors and Microcontrollers', DhanpatRai Publications (P) Ltd., 2008.

SUBJECT TITLE: INSTRUMENTATION ENGINEERING

SUBJECT CODE: IMEL-305

SEMESTER: 5
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To acquire knowledge about the various elements of instrumentation systems.
2. To acquire knowledge about working of data acquisition and corresponding signal conditioning.
3. To know about different types of display devices and recorders.

Course Outcomes:

1. Student will get knowledge about various types of transducers, signal conditioning and data acquisition systems.
2. Students will get acquainted with digital measurement systems, display devices and recorders.
3. Students will be able to know about data transmission and telemetry.

UNIT-I (12 Hrs.)

Transducers: Introduction to sensors, transducers, detectors, actuators, Electrical transducers, and its classification, Characteristics and choice of transducers, Resistive and Capacitive transducers, Potentiometers, Strain gauges and its types, Thermistors, RTD, Thermocouples, LVDT, RVDT, Piezo electric transducers, Hall effect transducers, Encoders,

UNIT-II (10 Hrs.)

Signal Conditioning: Introduction, role of operational amplifiers in signal conditioning, characteristics of op-amps, instrumentation amplifier, filters, general consideration of A/D and D/A convertors.

Data Acquisition Systems: instrumentation systems and its types, Analog data acquisition system, Digital data acquisition system, recorders, multiplexing and sample/hold circuits in data acquisition system.

UNIT-III (10 Hrs.)

Display Devices: Introduction, digital display methods, segmental displays, Dot Matrices, rear projection display, LED, LCD, segmental gas discharge displays, Electronic counters, digital voltmeters and its types.

Recorders: Requirement of recording, Analog and digital recorders, Graphic recorders,Strip chart recorders, Null type recorders, Potentiometric type recorders, single and multi-point recorders, X-Y records, Ultraviolet recorders, magnetic tape recorders, Frequency and pulse duration modulation type recording, Introduction to direct recording.

UNIT-IV (8 Hrs.)

Digital Measurement Systems: Introduction, types of tools used in digital systems, digital instruments and its types, microprocessor based instrumentation

Data Transmission and Telemetry: methods of data transmission, general telemetry systems, types of telemetry systems, modulations in telemetry, transmission and media channels.

Recommended Books

1. Halfrick Albert D. and Cooper Willium D., 'Modern Electronic Instrumentation and Measurement Techniques', PHI, 1990.
2. A.K. Sawhney, 'Electronic Instrumentation and Measurement', 19thEdn.,DhanpatRaiand Sons, 2011.
2. Jones Larry D. and Chin A. Foster, 'Electronic Instruments and Measurement', 2ndEdn.,1995.
3. Morris Alan S. and Langari Reza, 'Measurement and Instrumentation, Theory and Applications', Academic Press, Elsevier, 2016.
4. Malaric Roman, 'Instrumentation and Measurement in Electrical Engineering', BrownWalker Press, Boca Raton, Florida, USA, 2011.
5. David Bell, 'Electronic Instrumentation and Measurements', 2ndEdn.,PHI, 2003.
6. M.M.S. Anand, 'Electronic Instruments and Instrumentation Technology', PHI, 2004.
7. H.S. Kalsi, 'Electronic Instrumentation', 2ndEdn.,TMH, 2004.

6TH Semester

SUBJECT TITLE: SYNCHRONOUS MACHINES

SUBJECT CODE: SYML-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To make the students aware about the general aspects of synchronous machines.
2. To apprise the students about the construction, operation and characteristics of alternators and synchronous motors.
3. To make them to understand the underlying aspects of parallel operation of alternators.

Course Outcomes:
Students will be able to

1. Understand about the general aspects and winding terminology used in 3-ϕ synchronous machines and 1-phase synchronous motors.
2. Analyse the various methods of voltage regulation and EMF equations of alternators.
3. Memorize power-angle characteristics of synchronous machines and the working and characteristics of synchronous motors.
4. Understand the concepts about parallel operation and transient conditions of alternators.

UNIT-I (10 Hrs.)

General Aspects: Construction and working principle of synchronous machines, Excitation systems, Production of sinusoidal electromotive force (EMF) and its equation, flux and magnetomotive force (MMF), phasor diagrams, cylindrical and salient pole rotors, pitch factor, distribution factor.

UNIT-II (14 Hrs.)

Alternators: Construction, Phasor diagram of cylindrical rotor alternator, ratings, armaturere ction, determination of synchronous reactance; open-circuit and short- circuit characteristics, short-circuit ratio, short-circuit loss. Determination of voltage regulation: EMF, MMF and zero power factor method. Power flow through inductive impedance,

Power-angle characteristics of cylindrical and salient pole synchronous machines, Two-reaction theory of salient pole machines, power factor control.

UNIT-III (12 Hrs.)

Synchronous Motors: Operating characteristics, power-angle characteristics, condition for maximum power, V-curves and inverted V-curves, methods of starting, synchronous motor applications, synchronous condenser, Hunting, damper windings, Hysteresis motors.

UNIT-IV (12 Hrs.)

Parallel Operation of Alternators: Conditions for synchronization of single phase andthree phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing.

Recommended Books

1. P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 2010.
2. A.E. Fitzgerald, C. Kingsley and S.D. Umans, 'Electric Machinery', 6thEdn.,McGrawHill.
3. I.J. Nagrath and D.P. Kothari, 'Electrical Machines', 4thEdn.,Tata McGraw Hill, 2011.
4. M.G. Say, 'Alternating Current Machines', 5thEdn., Sir Isaac Pitman and Sons Ltd., 2004.
5. S. SarmaMulukutla and Mukesh K. Pathak, 'Electric Machines', 3rd Indian Reprint, CENGAGE Learning, 2009.

SUBJECT TITLE: POWER SYSTEM-I (TRANSMISSION AND DISTRIBUTION)

SUBJECT CODE: PS1L-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To introduce the students to the structure of power and distribution systems.
2. To introduce them to overhead transmission lines and underground cables and make them to understand their operating characteristics.
3. To make them familiar with the components and the mechanical design aspects of overhead transmission lines.

Course Outcomes:

1. Students will be able to understand power distribution systems.
2. Students will be skilled to analyse performance of transmission lines and underground cables.
3. Students will be able to select and design overhead line insulators and transmission lines.

UNIT-I (12 Hrs.)

Structure of Power System: Growth of power systems: Indian overview, Interconnections and their advantages, Electricity act 2003, Environmental and safety measures. **Distribution Systems:** DC 2-wire and 3-wire systems, AC single phase, three phase and 4-wire systems, and comparison of copper efficiency. Distribution Systems: primary and secondary distribution systems, concentrated and uniformly distributed loads on distributors; one and both ends, ring distribution, sub mains and tampered mains.

UNIT-II (12 Hrs.)

Overhead Transmission Lines: Materials and types of conductors, line parameters; calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, generalized ABCD constants and equivalent circuits of short, medium and long lines. Line performance: regulation and efficiency of short, medium and long lines, series and shunt compensation.

UNIT-III (12 Hrs.)

Overhead Line Insulators and Mechanical Design of Transmission Lines: Type, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance. Different types of towers, sag-tension calculations, Corona-losses, radio and audio noise, transmission line–communication line interference, Comparison of EHVAC and HVDC transmission systems.

UNIT-IV (12 Hrs.)

Underground Cables: classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.

Recommended Books

1. D.P. Kothari and I. J. Nagrath, 'Power System Engineering', Tata McGraw Hill, 2007.
2. J.B. Gupta, 'Transmission and Distribution of Electrical Power', Katson Books, 2013.
3. C.L. Wadhwa, 'Electric Power Systems', 7thEdn.,New Age International Publishers, 2016.
4. J. Grainger John and Jr. W.D. Stevenson, 'Power System Analysis', McGraw Hill, 1994.

SUBJECT TITLE: ELECTRICAL MACHINES-II LAB

SUBJECT CODE: EM1P-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Course Objectives:

1. To plot speed-torque characteristics of three-phase and single-phase induction motors.
2. To obtain equivalent circuit parameters of three-phase and single-phase induction motors.
3. To study speed control of induction motors using different techniques.
4. To plot characteristics of a three-phase alternator and a synchronous motor.
5. To synchronise two 3-phase alternators by different methods

Course Outcomes:

Students will be able to

1. Obtain equivalent circuit parameters of single-phase and three- phase Induction motors.
2. Control speed of Induction motors by different methods.
3. Draw open and short circuit characteristics of three-phase alternator and V and inverted V curves of synchronous motor.
4. Find out voltage regulation of an alternator by different tests.
5. Synchronise two or more 3-phase alternators.

EXPERIMENTS

1. To perform load-test on three-phase induction motor and to plot speed-torque characteristics.
2. To perform no-load and blocked rotor test on three-phase induction motor to obtain equivalent circuit parameters and to draw circle diagram.
3. To study the speed control of three-phase induction motor by Kramer's method.
4. To study the speed control of three-phase induction motor by cascading of two induction motors.
5. To study star- delta starters and
   a) To draw electrical connection diagram.
   b) To start the three-phase induction motor using it.
   c) To reverse the direction of three-phase induction motor.

6. To start a three-phase slip ring induction motor by inserting different levels of resistance in the rotor circuits and to plot speed- torque characteristics.
7. To perform no-load and blocked rotor test on single-phase induction motor and to determine the parameters of equivalent circuit.
8. To perform load test on single-phase induction motor and plot speed-torque characteristics.
9. To perform no load and short circuit test on three-phase alternator and draw open and short circuit characteristics.
10. To find voltage regulation of an alternator by zero power factor (ZPF) method.
11. To study effect of variation of field current upon the stator current and power factor of synchronous motor running at no load and draw V and inverted V curves of motor.
12. To synchronise two 3-phase alternators using dark lamp method, and two-bright & one dark lamp method.
13. To start a synchronous motor using appropriate method.

Note: At least ten experiments should be performed in the semester.

SUBJECT TITLE: PROGRAMMING IN MATLAB

SUBJECT CODE: PIMP-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Course Objectives:

1. To introduce to BASIC built in functions of MATLAB and blocks of SIMULINK.
2. To learn to do various programming operations in MATLAB and develop Simulink models in SIMULINK.
4. To learn to plot various types of graphs in MATLAB.

Course Outcomes:

1. Students will know about BASIC built in functions of MATLAB and blocks of SIMULINK.
2. They will learn to do various programming operations in MATLAB and develop Simulink models in SIMULINK.
3. They will be able to draw 2-D and 3-D plots in MATLAB.

EXPERIMENTS

1. Introduction to Fundamentals of MATLAB Programming.
2. To perform Arithmetic and logic operations in MATLAB.
3. To perform branch and loop operations in MATLAB.
4. To use basic built-in function of Matrices in MATLAB.
5. To develop a user defined function file in MATLAB.
6. To plot 2-D & 3-D graphs in MATLAB, such as plots, subplots, logarithmic plots and multiple plots etc.
7. To plot 3-phase AC supply voltage in MATLAB.
8. To develop MATLAB program to calculate ABCD parameters of transmission line.
9. Introduction to commonly used blocks of SIMULINK.
10. To develop Simulink model to show series resonance phenomenon and to plot voltage & current waveforms and frequency vs impedance graph.
11. To develop Simulink model to show parallel resonance phenomenon and plot voltage & current waveforms and frequency vs admittance graph.

12. To develop a Simulink model of symmetrical three phase power system supplying a three phase balanced load and to display the three phase voltage, current, active and reactive power.

13. To develop Simulink model of three phase transformer and to display the primary and secondary voltages and currents.

14. To develop Simulink model for speed control of dc motors.

Note: At least ten experiments should be performed in semester.

Recommended Books

1. TyagiAgam Kumar, 'Matlab and Simulink for Engineers', Oxford Publishers, 2012.
2. S. Swapna Kumar, S.V.B. Lenina, 'MATLAB Easy Way of Learning', PHI, 2016.
3. Stephen J. Chapman, 'MATLAB Programming for Engineers', Cengage Learning, 2015.

SUBJECT TITLE: SOFT SKILLS-IV

SUBJECT CODE: SS4P-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

Course Objectives:

The course aims at the key areas like conversation skills, group skills and persuasion skills required during the interview process in an organization

Course Outcomes:

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

1. Demonstrate soft skills required for business situations.
2. Analyze the value of soft skills for career enhancement.
3. Apply soft skills to workplace environment.
4. Confidently participate in GD and interview process.

UNIT-1

Art of Speaking: Introduction. Communication process. Importance of communication, channels of communication. Formal and informal communication. Barriers to communication.Tips for effective communication.tips for conversation. Presentation skills.Effective multi-media presentation skills. Speeches and debates.Combating nervousness.Patterns and methods of presentation.Oral presentation, planning and preparation.

UNIT-2

Group Discussion: Introduction. Importance of GD. Characters tested in a GD. Tips onGD. Essential elements of GD. Traits tested in a GD .GD etiquette. Initiating a GD. Non-verbal communication in GD. Movement and gestures to be avoided in a GD.Some topics for GD.

UNIT-3

Preparing Cv/Resume: Introduction–meaning–difference among bio-data, CV and resume. CV writing tips. Do's and don'ts of resume preparation. Vocabulary for resume, common resume mistakes, cover letters, tips for writing cover letters.

UNIT-4

Interview Skills: Introduction. Types of interview. Types of question asked. Reasons forrejections.Post-interview etiquette.Telephonic interview.Dress code at interview.Mistakes during interview.Tips to crack on interview. Contextual questions in interview skills. Emotional crack an interview. Emotional intelligence and critical thinking during interview process.

Recommended Books

1. K. Alex, S. Chand Publishers.
2. Lucas, E. Stephen, 'The Art of Public Speaking', 11thEdn., International Edn., McGrawHill Book Co.,2014.
3. Goleman, Daniel, 'Working with Emotional Intelligence', Banton Books, London, 1998.
4. Thrope, Edgar and Showick Trope, 'Winning at Interviews', Pearson Education,2004.
5. Turk, Christopher, 'Effective Speaking', South Asia Division: Taylor & Francis, 1985.

SUBJECT TITLE: ELECTRICAL POWER UTILIZATION

SUBJECT CODE: EPUL-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To acquire knowledge about various elements of A.C and D.C electric motor drives and their characteristics.
2. To acquire detailed knowledge about electric traction systems.
3. To know various phenomena related to electrolytic processes and illumination.

Course Outcomes:

1. Students will get knowledge about D.C and A.C electric motor drive characteristics and select them for particular traction systems.
2. They will be able to explore and control various electric heating and welding methods and processes.
3. They will be able to calculate illumination requirements.

UNIT-I (14 Hrs.)

Electric Drives: Introduction concept of electric drives, classification of electric drives, nature of load, factors effecting selection of drive, Running characteristics of D.C, Series and shunt motor, 3-phase induction motor, 3-phase synchronous motor and A.C series motors, Starting methods of D.C series and shunt motors, starting methods of 3-phaseinduction motors, examples, starting methods of synchronous motors and single-phase induction motor. Speed control of D.C series and shunt motors, examples, Speed control of 3- phase induction motor, examples, Methods of electric braking of D.C motor, examples. Braking of 3-phase induction motor, Mechanical features of electric drive, Load equalization, flywheel calculations, examples. Temperatures rise of electric drives, heating and cooling curves, standard ratings of motors, examples Applications of electric drives and selection of drives for particular service, conservation approach to be considered.

UNIT-II (10 Hrs.)

Electrical Traction: Introductions, different traction systems, various systems of electric traction. Locomotives, tramways, trolleys, track electrification, comparison between A.C and D.C systems of railway electrification, Types of speed and speed-time curves, examples. Mechanics of train movement, tractive effort, power, output, examples., Energy output from driving axles, energy output using simplified speed-time curves, examples, Factors affecting energy consumption, dead weight, accelerating weight, adhesion weight, examples., Traction motors and their characteristics, starting and speed control of D.C series and shunt motors, examples, Starting and speed control of A.C series and 3-phase induction motors, Braking of traction motors and mechanical considerations, conservation approach to be considered.

UNIT-III (8 Hrs.)

Electrical Heating and Welding: Advantages of electric heating, modes of transfer of heat, classification of electric heating methods, Resistances heating methods, requirements of heating elements, design of heating elements, methods of temperature control, problems, Induction heating: principle, types of induction furnaces, direct core type, vertical core type, indirect core type, core less type, advantages and disadvantages, eddy current heating, applications examples., Arc-furnace: principle, types, direct and indirect arc furnaces, power supply and control, condition for maximum output, examples., Dielectric heating: principles, advantages and disadvantages, applications, choice of frequency, examples., Electric welding: different types of resistance welding and electric arc welding, conservation approach to be considered.

UNIT-IV (8 Hrs.)

Electrolytic Process: Principle, Faradays laws of electrolysis, current efficiency, energy efficiency etc., Rating of metals, production of chemicals, Electro deposition, electroplating, power supply for electrolytic processes.

Illumination: Nature of light, definitions, laws of illumination, different types of lamps, tungsten lamp, discharge lamp, sodium vapour lamp, fluorescent lamp, design of lighting scheme, methods of lighting, calculations, examples, flood lighting, factory lighting and street lighting, examples., conservation approach to be considered.

Recommended Books

1. Deb Tanmoy, ‘Utilization of Electric Power and Traction’, Ane Books-New Delhi, 2012.
2. R.K. Rajput, ‘Utilization of Electrical Energy’, Luxmi Publications Pvt. Ltd., 2006.
3. J.B. Gupta, ‘Utilization of Electric Power & Electric Traction’, S.K. Kataria and Sons, Katson Books, 2013.
4. C.L. Wadhwa, ‘Generation, Distribution and Utilization of Electrical Energy’, New age International Pvt. Ltd., Publishers, 2005.
5. Tarlok Singh, ‘Utilization of Electric Energy’, S.K. Kataria and Sons, Katson Books, 2010.

SUBJECT TITLE: ENERGY AUDITING AND MANAGEMENT

SUBJECT CODE: EAML-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To understand the importance of energy management and Audit.
2. To study various types of energy dissipating systems such as electrical, compressed air system, HVAC and refrigeration systems.
3. To understand energy audit processes of these systems used in the industry.

Course Outcomes:

1. Students will gain the knowledge about various types of energy dissipating systems.
2. Students will be able to perform the energy audit for various equipment used in daily life.
3. Students will learn the use of various instruments used in energy audit process.

UNIT-I (14 Hrs.)

Energy Scenario: Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act-2001 and its features.

Energy Management and Audit: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments

UNIT-II (10 Hrs.)

Material and Energy Balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams.

Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques- Simple payback period, Return on investment, Net present value, Internal rate of

return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of ESCOs.

UNIT-III (8 Hrs.)

Electrical System: Electricity tariff, Load management and maximum demand control, Power factor improvement, Distribution and transformer losses. Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, energy efficient motors. Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues.

Compressed Air System: Types of air compressors, Compressor efficiency, efficient compressor operation, Compressed air system components, Capacity assessment, Leakage test Factors affecting the performance and efficiency

UNIT-IV (8 Hrs.)

HVAC and Refrigeration System: Vapor compression refrigeration cycle, Refrigerants, Coefficient of performance, Capacity, Factors affecting refrigeration and air conditioning system performance and savings opportunities, Vapour absorption refrigeration system: Working principle, Types and comparison with vapour compression system, Saving potential, Fans, Blowers and pumps- Types, Performance evaluation, efficient system operation, Flow control strategies and energy conservation opportunities.

Recommended Books

1. Y.P. Abbi and S. Jain, 'Handbook on Energy Audit and Environment Management', T.E.R.I. Press, 2006.
2. Doti Steve, PE, CEM, 'Commercial Energy Auditing Reference Handbook', CRC Press,Taylor & Francis Group, 2010.
3. Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education, New Delhi, 2017.
4. Al-ShemeriTarik, 'Energy Audits, A workbook for Energy Management in Buildings', John Wiley & Sons, 2011.
5. Capehart, Turner and Kennedy, 'Guide to Energy Management', CRC Press, Taylor &Francis Group, 2008.

SUBJECT TITLE: SUBSTATION EQUIPMENT AND DESIGN

SUBJECT CODE: SEDL-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To provide knowledge about substation, its layout and main equipment present in it.
2. To impart knowledge about power, current and potential transformer.
3. To understand the importance of reactive power management and the use of capacitor banks in reactive power management.
4. To introduce to elementary design considerations of substation equipment.

Course Outcomes:

1. Students will get familiar with main equipment used in substations and their design considerations.
2. They will be able to know the use of different types of transformers used in substations.
3. They will develop understanding about importance of reactive power and its management by use of capacitor banks.

UNIT-1 (10 Hrs.)

Substation: Introduction, classification and layout of substation, Single Bus bar, Mesh Substation, Factors affecting layout of substation, types of bus bars, Substation equipment specifications, testing of substation Equipment.

Power Transformer: Introduction and Working Principle of Power Transformer, Classification and their types, important characteristics of Transformer Oil.

UNIT-II (8 Hrs.)

Current Transformers (CT): Basic functions of Current Transformer, Rating and Performance of CTs, Burden, Theory and Operation of CT, Diagram of CT's Connection of Power Transformer and Selection of CT.

Potential Transformers (PT): Terminology, requirement of VA Burden, Testing and Commissioning of PTs, Capacitor Voltage Transformer.

Earthing: Introduction and purpose of Earthing, tolerable limits of body currents, soil resistivity, earth resistance and its measurement, tolerable and actual step and touch voltage, types of Earthing, Design of Earthing grid, impulse Behavior of Earthing system, grounded and ungrounded neutral system, Types, M ethods and selection of grounding neutral.

UNIT-III (8 Hrs.)

Reactive Power Management: Introduction to Reactive Power & its Importance in Power System, Sources of Generation & Absorption of Reactive Power, Reactive Power Compensation & its Advantages, Various types of Reactive Power Compensation and its Calculation, Static Synchronous Compensator, Unified Power Flow Controller.

Capacitor Banks: - Need for Reactive Compensation, Power Factor Improvement and its Benefits, Purpose of Installation of Capacitor Bank, Protection of Capacitor Bank and Pre-Commissioning Checks and tests, Series and Shunt Compensators, Rating and operation of Shunt Capacitor banks.

UNIT-IV (12 Hrs.)

Station Battery and Charging Equipment: Introduction, Variable Load Battery and System Tester, Testing of Battery Charger and Battery, Types of Batteries, Basic Charging Methods.

Elementary Idea of Substation Equipment Design: Substation equipment ratings and its operation from design view point, selection of cables, Isolator Design, Overhead line terminations, bus bar size calculations and panel design, design of Surge Arrestor, selection of power transformer.

Computer Applications in Substation Engineering: Introduction, System Components, Communication Infrastructure and Methods, Trends in SCADA, Remote Terminal Unit, MODEM.

Recommended Books

1. R.S. Dahiya and VinayAttri, 'Sub Station Engineering, Design, Concepts and Computer Application', S.K. Kataria& Sons, 2013.
2. S. Rao, 'Electrical Substation Engineering and Practice', Khanna Publishers, 1992.
3. P.S. Satnam and P.V. Gupta, 'Substation Design and Equipment', DhanpatRaiPublications, 2013.
4. Mcdonald John D., 'Electric Power Substations Engineering', 3rd Edn., CRC Press, 2012.

SUBJECT TITLE: DIGITAL CONTROL SYSTEMS

SUBJECT CODE: DCSL-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To introduce to discrete data control systems, digital signals, sample and hold circuits etc.
2. To study transfer functions and application of z-transforms.
3. To study time response, frequency response and state space techniques of continuous data and discrete data digital control signals.

Course Outcomes:

1. The students will get knowledge about the basics of digital control systems.
2. They will be able to find out the time response and frequency response of these systems
3. They will get skilled to design digital control systems with digital controllers.

UNIT-I (10 Hrs.)

Introduction: Basic Elements of discrete data control systems, advantages of discrete data control systems, examples.

Signal Conversion and Processing: Digital signals and coding, data conversion and quantization, sample and hold devices, Mathematical modeling of the sampling process; Data reconstruction and filtering of sampled signals: Zero order hold, first order Hold and polygonal hold.

UNIT-II (10 Hrs.)

Review of z-Transforms, Applications of z-Transforms to Difference equations, Modifiedz- Transforms, transfer functions, Block diagrams, signal flow graphs: Introduction, Pulse Transfer function, and z-Transfer function, Discrete Data System with cascaded elements separated by a sampler and not separated by a sampler. Closed loop systems, characteristic equation in discrete domain, causality and physically realizable systems; The Sampled signal flow graph.

UNIT-III (10 Hrs.)

Time Response: Comparison of continuous data and discrete data, Steady state error analysis of digital control systems, correlation between time response and root locations in s-plane and z-plane, Root loci for digital control systems, Effects of adding poles and zeros

to open loop transfer function, discrete data systems: Stability tests of discrete data systems: Bilinear transformation method, extension of RH criterion, Jury's Stability Test. **Frequency – Domain Analysis:** Polar plot of GH (z), Nyquist stability criterion, Bode plot,Gain Margin and Phase margin, Nicholas chart, Band width considerations, sensitivity analysis.

Unit–IV (8 Hrs.)

State Space Techniques: Review of continuous data systems, state equations of discrete data systems with sample and hold devices, state diagrams of digital systems, Decomposition of discrete data transfer function, state variable analysis of response between sampling instants, Controllability, Observability of LTI discrete data systems.

Design of digital control systems with digital controllers through bilinear transformation. Digital PID controller, Design for dead-beat response, pole placement design by incomplete feedback or output feedback.

Recommended Books

1. B.C. Kuo, Digital Control Systems, Oxford University Press, 1995.
2. K. Ogata, 'Discrete Time Control Systems', 2ndEdn.,Pearson, 2015.
3. K. Ogata, 'Digital Control Engineering', Prentice Hall, Englewood Cliffs, 1995.
4. M. Gopal, 'Digital Control Engineering', Wiley Eastern, 1988.

SUBJECT TITLE: ENERGY EFFICIENT MACHINES

SUBJECT CODE: EEML-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To make the students aware about the basics and need for energy efficient machines.
2. To make them familiar with the energy efficient motors and their applications.
3. To make them to understand the underlying aspects of economics of energy efficient systems.

Course Outcomes:

1. The students will become aware about the need for energy efficient machines.
2. They will come to know about the energy efficient motors and their applications.
3. They will understand the underlying aspects of economics of energy efficient systems.

UNIT-I (8 Hrs.)

Introduction: Need for energy efficient machines, energy cost and two-part tariff, energy conservation in industries and farms -a necessity, introduction to energy management and energy audit system.

UNIT-II (12 Hrs.)

Energy Efficient Motors: Review of induction motor characteristics, Standard motor efficiency, energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labeling, energy efficient motor standards.

Power Factor: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and power factor.

UNIT-III (10 Hrs.)

Application of Electric Motors: Varying duty applications, Voltage variation, Voltage Unbalance, over motoring, Poly-phase induction motors supplied by adjustable frequency power supplies.

UNIT-IV (10 Hrs.)

Induction Motors and Adjustable Drive Systems: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads. **Economics of Energy Efficient Systems:** Motor life cycle, Direct Savings and pay back analysis, efficiency evaluation factor, present worth method with constant power costs, present worth method with increasing power costs, net present worth method.

Recommended Books

1. Andreas John C., 'Energy Efficient Electric Motors', CRC Press, 1992.
2. Emadi Ali, 'Energy Efficient Electric Motors', 3rdEdn.,CRC Press, 2004.
3. Thuman Albert, 'Introduction to Efficient Electric Systems Design', The Fairmount PressPrentice Hall, 1991.
4. S.C. Tripathi, 'Electric Energy Utilization and Conservation', Tata McGraw Hill,1991.
5. Charles Belove, 'Handbook of Modern Electronics and Electrical Engineering', JohnWiley and Sons, 1986.

SUBJECT TITLE: VIRTUAL INSTRUMENTATION

SUBJECT CODE: VIML-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To understand Virtual instrumentation and to realize the architecture of VI.
2. To familiarize with the VI software and learn programming in VI.
3. To study various instruments, interfacing and data acquisition methods.

Course Outcomes:

1. The students will be having skills of programming techniques.
2. They will be able to do data acquisition by creating Virtual Instruments for practical works.
3. Students will gain knowledge of analysis tools.

Unit - I (10 Hrs.)

Review of Virtual Instrumentation: Historical perspective, Advantages of virtual instrumentation system, Block diagram and architecture of a virtual Instrument, examples. **Data-flow Techniques:** Graphical programming in data flow, Front Panel, Block Diagram, Comparison with conventional programming, Instructions.

VI Programming Techniques: VIs and sub-VIs, Loops and charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, String and file I/O.

Unit -II (10 Hrs.)

Data Acquisition: Data acquisition boards, A/D Convertors, D/A Convertors, Digital Input and Output, Counters and timers, PC Hardware' structure, Timing, Interrupts, DMA Software and hardware installation.

Common Instrumentation Interfaces: Serial ports: RS-232, USB, Parallel ports: IEEE-1284, GPIB standard IEEE-488.2.

Unit -III (10 Hrs.)

Analysis Tools: Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering, VI Applications in various fields.

Advanced Interface Buses: System buses, USB, PCMCIA, PCI, VXI, SCXl, PXI, Networking basics for office and industrial applications, VISA and IVI, interfere tools for Image acquisition and processing, Motion Control.

Unit -IV (8 Hrs.)

Laboratory Work: Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multi-plot charts, Case structures, ASCII files, Function Generator, Waveform generation, use of Property Node, Formula node, shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ, Application of Data Acquisition system for measurement of temperature, pressure, Electrical quantities.

Recommended Books

1. G. Johnson, 'LabVIEW Graphical Programming', McGraw Hill,2006.
2. L. Sokoloft, 'Basic Concepts of LabVIEW 4', Prentice Hall Inc.,2004.
3. L.K. Wells and J. Travis, 'LabVIEW for Everyone', Prentice Hall Inc.,1996.
4. S. Gupta and J.P. Gupta, 'PC Interfacing for Data Acquisition and Process Control', Instrument Society of America, 1988.
5. 'LabView Tutorial Manual', National Instruments Corp., 1996-2010 www.ni.com.
6. 'LabVIEW Basics Course Manual', National Instruments Corp., USA, 1998-2010.
7. Jerome Jovitha, 'Virtual Instrumentation using LABVIEW', PHI, 2010.

SUBJECT TITLE: FLEXIBLE AC TRANSMISSION SYSTEM

SUBJECT CODE: FATL -306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To review the power electronics fundamentals.
2. To review power transmission fundamentals and to introduce the FACTS concept.
3. To introduce to the need of shunt and series compensation and UPFC.

Course Outcomes:

1. Students will refresh the power converters' fundamentals.
2. They will learn about need and applications of FACTS controllers.
3. They would develop understanding about shunt and series compensation and UPFC.

UNIT-I (10 Hrs.)

Power Electronics Fundamentals: Basic function of power electronics, Power semiconductor device for high power converters, Static power convertor structures, AC controller based structure, DC link convertor topologies, Convertor output and harmonic control.

UNIT-II (10 Hrs.)

Power Transmission Control: Fundamental of ac power transmission, Transmission problems and needs, the emergence of FACTS, FACTS control considerations, FACTS controllers.

UNIT-III (10 Hrs.)

Shunt and Series Compensation: Shunt SVC principles, Configuration and control, STATCOM, Configuration applications. Fundamental of series compensation using GCSC, TCSC and TSSC, Application of TCSC for different problems of power system, TCSC lay out, SSSC principle of operation.

UNIT-IV (10 Hrs.)

Unified Power Flow Controllers: Basic operating principles and characteristics, independent active and reactive power flow control, control of UPFC, installation, applications, UPFC model for power flow studies, comparison of UPFC with the controlled series compensators and phase shifters.

Recommended Books

1. A. Ghosh and G. Ledwich, 'Power Quality Enhancement Using Custom Power Devices', Kluwer Academic Publishers, 2005.
2. N.G. Hingorani and L. Gyragyi, 'Understanding FACTS: Concepts and Technology of Flexible AC Transmission System', Standard Publishers and Distributors,2005.
3. Y.H. Sang and A.T. John, 'Flexible AC Transmission Systems', IEEE Press,2006.
4. R.M. Mathur and R.K. Verma, 'Thyristor Based FACTS Controllers for Electrical Transmission Systems', IEEE Press, 2002.
5. T.J.E. Miller, 'Reactive Power Control in Electric Systems', John Wiley, 1982.

SUBJECT TITLE: NON-CONVENTIONAL ENERGY SOURCES

SUBJECT CODE: NCEL-306

SEMESTER: 6
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	0	0	3

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Course Objectives:

1. To obtain knowledge about renewable energy sources and solar energy and their utilization.
2. To introduce to wind energy conversion and bio-mass energy conversion systems.
3. To introduce to geothermal energy and energy from ocean. To make them aware about hydrogen energy sources.

Course Outcomes:

1. Students will get knowledge about utilization of renewable energy sources and solar energy.
2. They will learn about wind energy conversion and bio-mass energy conversion systems.
3. They will become aware about geothermal energy, energy from ocean and hydrogen energy sources.

UNIT-I (12 Hrs.)

Solar Energy: Conventional energy sources and availability, Introduction to new energy techniques & renewable energy sources; Solar Energy, Solar constant, Radiation geometry, Solar energy collectors, Concentrated and flat plate, Energy balance and collector efficiency, Solar energy storage, Application to space heating, distillation, cooking and greenhouse effect.

UNIT-II (12 Hrs.)

Wind Energy: Basic principle of wind energy conversion, site selection, analysis of aerodynamic forces acting on wind mill blades and estimation of power output. **Bio-energy**: Biomass conversion technology, photosynthesis, biogas plant, thermal gasification.

UNIT-III (8 Hrs.)

Geothermal Energy: Sources- hydrothermal, hot dry rock, geothermal fossil system, primem overs for geothermal energy.

Energy from Ocean: Ocean thermal electric conversion, energy from tides, small-scalehydroelectric development.

UNIT-IV (8 Hrs.)

Hydrogen Energy Sources: Introduction, hydrogen production methods, storage, utilization, magneto hydrodynamic power, thermionic generation, nuclear fusion energy.

Recommended Books

1. G.D. Rai, 'Non-Conventional Energy Sources', Khanna Publishers, Delhi, 2011.
2. S. Rao, B.B. Parulekar, 'Energy Technology: Non-Conventional Renewable and Conventional', Khanna Publishers, Delhi.
3. H.P. Garg and Jai Prakash, 'Solar Energy: Fundamentals and Applications', TataMcGraw Hill.
4. Saeed S. Hasan and D.K. Sharma, 'Non-Conventional Energy Resources', KatsonPublishers, 2014.
5. R.K. Rajput, 'Non-Conventional Energy Sources and Utilization', S. Chand Publishers, 2012.
6. S.P. Sukhatme, 'Solar Energy: Principles of Thermal Collection and Storage', TataMcGraw Hill, N. Delhi, 1984.
7. Sutton, 'Direct Energy Conversion', McGraw Hill Inc., 1966.

7th Semester

SUBJECT TITLE: NON-LINEAR AND DIGITAL CONTROL SYSTEMS

SUBJECT CODE: NDCL-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To make the students aware about digital control system, sampling process and Z-transform.
2. To introduce the students to state variable analysis and design of digital control systems.
3. To make them familiar with nonlinear control systems and to understand their stability criterion

Course Outcomes:

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

1. Analyze discrete time systems
2. Design and analyze digital controllers.
3. Understand Non Linear control systems and analyze their stability

UNIT-1 (12 Hrs.)

Sampled Data Systems: Introduction to digital control system**,** Sampling process, mathematical analysis of sampling process. Reconstruction of sampled signal, zero order and first order hold, Z- transform, evaluation of Z-transform, inverse Z-transform, limitations of Z-transform, mapping of S plane into Z plane, pulse transfer function, solution of discrete time state equations. Stability analysis of discrete time systems, Jury's stability test, extension of Routh-Hurwitz criterion to discrete time systems.

UNIT-2 (14 Hrs.)

State Variable Analysis: State variable representation of discrete time systems, solution of state variable models, Controllability and Observability, effect of pole-zero cancellation.

Design of Digital Control System: Design of Discrete PID Controller, Design of discretestate feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

UNIT-3 (12 Hrs.)

Non Linear Control Systems Analysis: Introduction and Characteristics, review of Fourier analysis.

Describing Function Analysis: Definition, limitations, use of describing function fors tability analysis, describing function of ideal relay, relay with hystersis, dead zone, saturation, coulomb friction and backlash.

UNIT-4 (10 Hrs.)

Stability Methods: Lyapunov's direct method, generation of Lyapunov's function by Krasovskii's and Variable Gradient methods.

Phase Plane Analysis: Singular points, Method of isoclines, delta method, phase portrait of second order nonlinear systems, limit cycle.

Recommended Books

1. K. Ogata, 'Modern Control Engineering', Prentice Hall, India,
2. I.J. Nagrath, M. Gopal, 'Control System Engineering', New Age Publications,.
3. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw Hill,
4. B.C. Kuo and F. Golnaraghi, 'Automatic Control System', Wiley Publications,
5. R.V. Dorf and R.H. Bishop, 'Modern Control Systems', Adison Wesley,
6. M. Gopal, 'Digital Control Engineering', Wiley Eastern,

SUBJECT TITLE: POWER SYSTEM-II (SWITCHGEAR AND PROTECTION)

SUBJECT CODE: PS2L-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To provide knowledge about principle and components of protective system.
2. To impart knowledge about basics of Substation, Isolator and Fuses
3. To provide knowledge about operating Principle, types of Relays and Circuit Breakers
4. To provide knowledge about protection of Feeder, Bus bar, Generator and Transformer

Course Outcomes:

1. Skill to understand about basic components of power system protection system
2. Skill to understand about basics of Substation, Isolator and Fuses
3. Skill to understand about Principle, Operation and types of Relays and Circuit Breakers
4. Skill to understand about Protection of Feeder, Bus bar, Generator and Transformer

UNIT- I (12 Hrs.)

Introduction to Components of Protection System: Need for Protective System, Nature and Causes of Faults, Types and Effects of Faults, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Basic Principle of Protective System, Components and Classification of Protective System, Brief Idea of Instrument Transformers, Circuit Breakers, Relays and related Terminologies.

Substation, Isolator and Fuses: Functions, Types, Classification, Main Equipment, Layout, Bus-bar Arrangement of Substation. Operation, Types and Rating of Isolators. Types, Rating and Characteristics of Fuses.

UNIT- II (12 Hrs.)

Circuit Breakers: Circuit Breaker Ratings, Arc Initiation and their Interruption Methods, Arc Quenching Theories, Re-striking voltage, Recovery Voltage, RRRV, Plain Break Oil Circuit Breaker, Minimum Oil Circuit Breaker, Air Circuit Breaker, Air Blast Circuit Breaker, Vacuum Circuit breaker and SF^6 Circuit Breaker. Introduction to D.C. Circuit Breaker.

Protective Relays: Introduction, Classification, Constructional Features; and Characteristics of Electromagnetic, Induction, Thermal, Over-current relays, Directional

Over Current Relay, Distance relays (Impedance, Reactance and Mho relay), Differential Relays, Trans-lay, Negative sequence relay, introduction to Static and Numerical Relays.

UNIT-III (12 Hrs.)

Feeder or Transmission Line Protection: Over current Protection by Time Graded System,Current Graded and Time- Current Graded System, Protection of Parallel Feeder, Protection of Ring Mains, Over Current Earth Fault Protection, Distance Protection of Transmission lines (Impedance, Reactance and Mho Relay), Comparison between Distance Relays, Differential and Percentage Differential Protection, Pilot Relaying Protection of Feeder.

Bus-Bar Protection: Differential Protection of Bus Bars **UNIT- IV (12 Hrs.)**

Transformer Protection: Over current protection, percentage differential protection, incipient faults in transformers, inter-turn fault, protection against over fluxing.

Generator Protection: Various faults and abnormal operating conditions, protection against unbalanced loading, over speeding, loss of excitation, loss of prime mover.

Recommended Books

1. C.L. Wadhwa, 'Electrical Power System', New Age International (P) Ltd.
2. D.N. Badri Ram, D.N. Vishakarma, 'Power System Protection and Switchgear'.
3. Ravindranath and M. Chander, 'Power System Protection and Switchgear'.
4. Dahiya and Attri, 'Substation Engineering', Khanna Publishers
5. B.R. Gupta, 'Power System Analysis and Design', S. Chand & Company (P) Ltd.
6. Nagrath and Kothari, 'Modern Power System Analysis', Tata McGraw Hill.
7. J. Grainger John and Jr. W.D. Stevenson, 'Power System Analysis', McGraw Hill, **1994**.
8. Sunil S. Rao, 'Switchgear Protection and Power Systems', Khanna Publishers.
9. S.L. Uppal, 'Electrical Power', Khanna Publishers.

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SUBJECT TITLE: SOFTWARE LAB.

SUBJECT CODE: SWFP-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

EXPERIMENTS

To develop algorithms/programs in C/ C++/MATLAB language for the following methods:

1. Bisection method for finding a real root of an equation.
2. Newton-Raphson method for finding a real root of an equation.
3. Gauss-Seidal iterative method for linear algebraic equations.
4. Trapezoidal Rule for numerical integration
5. Simpson's 1/3rd rule for numerical integration.
6. Simpson's 3/8th rule for numerical integration.
7. Lagrange's method for interpolation.
8. Euler's method for solving ordinary differential equations.
9. Modified Euler's method for solving ordinary differential equations
10. R-K method for solving ordinary differential equations.

Note: At least eight experiments must be performed from the given list.

SUBJECT TITLE: POWER SYSTEM-II LAB

SUBJECT CODE: PS2P-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

EXPERIMENTS

1. To study the performance of a transmission line. Also to find its ABCD parameters.
2. To find the operating characteristics of fuse (HRC or open type)
3. To find the resistance of earth electrode by three electrode method.
4. To find the resistivity of earth using four electrode method.
5. To study the radial feeder performance when
6. Fed at one end
7. Fed at both ends
8. To simulate different types of faults on transmission lines using demonstration panel/model or some available software.
9. To study different types of Insulators.
10. To obtain the Characteristics of over current relay.
11. To draw the characteristics of earth fault protection relay
12. To obtain the characteristics of under voltage and over voltage relay.
13. To obtain the characteristics of bimetallic miniature circuit breaker
14. To find the breakdown strength of transformer oil.
15. To demonstrate the operation of a Circuit breaker.
16. To draw the characteristics of Distance (Impedance, Reactance and Mho) Relay.

Note: At least ten experiments must be performed from the given list.

SUBJECT TITLE: SYSTEM ENGINEERING AND RELIABILITY

SUBJECT CODE: SERL-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To understand the reliability of engineering systems using different techniques.
2. To understand the qualitative concept of availability and maintainability.
3. To study about improvement of availability and reliability of any system.

Course Outcomes:

After studying this course, the students will be able to

1. Retrieve basic concept of system engineering and reliability.
2. Comprehend different reliability functions.
3. Analyze the failure data and reliability management.

UNIT-I (8 Hrs.)

Basic Concepts of System Engineering and Reliability: Introduction to System Engineering, Reliability and Quality, History of Reliability, Failure Modes, Causes of Failure (Unreliable Systems).

UNIT-II (12 Hrs.)

Reliability Design and Analysis: Reliability and Cost, Failure Data Analysis, Failure Density, Failure Rate, Component Reliability, Mean Time to Failure (MTTF), Mean Time Between Failure(MTBF), Markov's Model of Reliability Function.

UNIT-III (16 Hrs.)

System Reliability Models: Introduction, System with Series and Parallel Components, kout of m Systems, Fault Tree Analysis (FTA), Reliability evaluation from Fault Tree.
Maintainability and Availability Concepts: Concept of Maintainability, Qualitative aspect of Availability, Availability Function, Concept of Preventive Maintenance.

UNIT-IV (12 Hrs.)

Reliability Management: Economic Issues Manufacture and Customer Cost, Reliability Achievement Cost Model, Reliability Management Policies, Objectives, Reliability Data Acquisition, Managing People for Reliability.

Recommended Books

1. M.L. Shooman, 'Probabilistic Reliability: An Engineering Approach', McGraw Hill.
2. E. Balaguruswamy, 'Reliability Engineering', McGraw Hill International DIGITAL

3. L.S. Srinath, 'Reliability Engineering', East-West Press Private Ltd.
4. R. Rama Kumar, 'Engineering Reliability', Prentice Hall, NJ.
5. R. Billinton, 'Power System Reliability Calculation', MIT Press, USA
6. Endreyni, 'Reliability Modeling in Electric Power System', John Wiley, New York.
7. https:// en.m.wikipedia.org/reliability engineering.
8. https://onlinecourses.nptel.ac.in

SUBJECT TITLE: DIGITAL SIGNAL PROCESSING

SUBJECT CODE: DSPL-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To familiarize the students with the basics of signal processing for analysis of discrete signals.
2. To acquaint the students with the application of different tools required for the analysis of discrete signals.
3. Application of digital signals to real-life problems.

Course Outcomes:

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

1. Represent signals mathematically in discrete-time, and in the frequency domain and analyze them using z-transform.
2. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
3. Design digital filters for various applications.
4. Apply digital signal processing for the analysis of real-life signals.

UNIT-I (10 Hrs.)

Discrete-time Signals and Systems: 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 Nyquest 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, Introduction to bilateral Z-transforms.

UNIT-II (10 Hrs.)

Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform(DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems

UNIT-III (12 Hrs.)

Digital Filter Structure: Describing Equation, Structures for FIR Systems and Structure for IIR Systems. Representation of Structures using Signal Flow Graph.

Design of Digital Filters: Design of FIR Digital filters, Window method, Park-McClellan'smethod, Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations, Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design, Finite Word-length Effects, Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

UNIT-IV (8 Hrs.)

Applications of Digital Signal Processing: Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Hardware Architecture of DSP Processor: Introduction, Desirable features of DSP processors, Types of architectures, Internal architecture of ADSP-21xx family, Features of ADSP-21xx family processors.

Recommended Books

1. S.K. Mitra, 'Digital Signal Processing: A Computer based Approach', McGraw Hill, **2011**.
2. A.V. Oppenheim and R.W. Schafer, 'Discrete Time Signal Processing', Prentice Hall, **1989**.
3. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing: Principles', Algorithms and Applications', Prentice Hall, **1997**.
4. L.R. Rabiner and B. Gold, 'Theory and Application of Digital Signal Processing', Prentice Hall, **1992**.
5. J.R. Johnson, 'Introduction to Digital Signal Processing', Prentice Hall, **1992**.

SUBJECT TITLE: EHVAC-TRANSMISSION

SUBJECT CODE: EVTL-307

SEMESTER: 7
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To familiarize the students with the need and advantages associated with EHVAC Transmission.
2. To acquaint the students with the reactive parameters of lines and methods of voltage control.
3. To make them aware about voltage gradients of conductors and effects of corona.

Course Outcomes:

At the end of this course, students will become aware

1. About the advantages of EHVAC Transmission and problems associated with it.
2. About the reactive parameters of lines and methods of voltage control.
3. About the voltage gradients of conductors and associated corona effects.

UNIT– I (8 Hrs.)

Preliminaries: Necessity of EHV AC transmission, advantages and problems, powerhandling capacity and line losses, mechanical considerations, resistance of conductors, properties of bundled conductors, bundle spacing and bundle radius, Examples.

UNIT – II (12 Hrs.)

Line and Ground Reactive Parameters: Line inductance and capacitance, sequence inductances and capacitances, modes of propagation, ground return, Examples

Voltage Control: Power circle diagram and its use, voltage control using synchronous condensers, cascade connection of shunt and series compensation, sub synchronous resonance in series capacitor, compensated lines, static VAR compensating system.

UNIT – III (12 Hrs.)

Voltage Gradients of Conductors: Electrostatics, field of sphere gap, field of line charges and properties, charge, potential relations for multi-conductors, surface voltage gradient on conductors, distribution of voltage gradient on sub conductors of bundle, Electrostatic field, calculation of electrostatic field of EHV/AC lines, effect on humans, animals and plants,

electrostatic induction in un-energized circuit of double-circuit line, electromagnetic interference, No load voltage conditions and charging current.

UNIT – IV (8 Hrs.)

Corona Effects: Power loss and audible noise (AN), corona loss formulae, charge voltage diagram, generation, characteristics, limits and measurements of AN, relation between 1-phase and 3-phase AN levels, Radio interference (RI), corona pulses: generation, properties, limits, frequency spectrum, modes of propagation, excitation function, measurement of RI, RIV and excitation functions.

Recommended Books

1. R.D. Begamudre, 'EHVAC Transmission Engineering', New Academic Science, 4th Edn.,
2. S. Rao, 'EHVAC and HVDC Transmission and Distribution Engineering', 3rd Edn., Khanna Publishers,.

EIGHT SEMESTER

SUBJECT TITLE: POWER SYSTEM ANALYSIS AND DESIGN

SUBJECT CODE: PSAL-308

SEMESTER: 7

CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To understand the importance of per unit system, single line diagram and impedance diagrams of electric networks in power system analysis.
2. To gain the information about various types of buses in the electric network and the type of data required for power flow studies.
3. To understand the different types of faults in the system and methods to analyze these faults.

Course Outcomes:

Students will be able to

1. Develop per unit system models of synchronous machines, transformers, transmission lines and static loads for power system studies.
2. Perform load flow studies by using bus admittance matrix and to do fault analysis by bus impedance matrix.
3. Compare features of Gauss-Siedel, Newton-Raphson and Fast decoupled methods of load flow analysis.
4. Analyze the effect of symmetrical and unsymmetrical faults on power system.
5. Analyze the effect of small and large disturbances on power system stability.

UNIT-I (18 Hrs.)

System Modelling: System modelling of synchronous machines, transformers, transmission lines and loads, Per Unit (p.u.) representation of power system, Single line diagram of electrical networks, p.u. single phase impedance diagrams corresponding to single line diagram, formulation of Bus Admittance Matrix and Bus Impedance Matrix for power system studies.

Load Flow Studies: Data for the load flow studies, Bus types, Formulation of power flow equations, Iterative solutions of load flow equations by the Gauss-Seidel and Newton-Raphson methods, Algorithms and flow charts of these methods, Line flows and line losses calculations. Introduction to Decoupled and Fast Decoupled method.

UNIT-II (12 Hrs.)

Fault Analysis: Transients on transmission line, Short circuit of synchronous machine, Selection of circuit breakers, Symmetrical fault analysis using Thevenin's theorem. Symmetrical Component Transformation, Construction of sequence networks of power systems. Analysis of Unsymmetrical LG (line to ground), LL (line to line), LLG (line line ground) faults using symmetrical components, Symmetrical and unsymmetrical faults analysis using Bus Impedance Matrix with algorithm and flow chart.

UNIT-III (10 Hrs.)

Power System Stability: Steady state stability, Dynamics of a synchronous machine, Power angle equation, Transient stability, Equal area criterion, Numerical solution of swing equation, Factors effecting transient stability.

UNIT-IV (08 Hrs.)

Design of Transmission Line: Choice of voltage, Selection of conductor size, Choice of span, No. of circuits, Conductor configuration, Insulation design, Selection of ground wire.

Recommended Books

1. O.I. Elgerd, 'Electric Energy Systems Theory', Tata McGraw Hill.
2. W.D. Stevenson, 'Elements of Power System Analysis', Tata McGraw Hill.
3. I.J. Nagrath and D.P. Kothari, 'Power System Engineering', Tata McGraw Hill.
4. J. Arrillaga and C.P. Arnold, 'Computer Aided Power System', Wiley.

SUBJECT TITLE: HIGH VOLTAGE ENGINEERING

SUBJECT CODE: HVEL-308

SEMESTER: 8
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To know about how power systems are subjected to over voltages and what are protection methods adopted against these over voltages.
2. To understand the basic physical phenomenon related to various breakdown processes in solid, liquid and gaseous insulating materials at high voltages.
3. To know about generation and measurement of D. C., A.C., & Impulse voltages.
4. To know about various tests on H. V. equipment and on insulating materials, as per the standards.

Learning Outcomes:

1. Explain that how over-voltages arise in a power system, and protection against these over-voltages.
2. Understand the basic physical phenomenon occurring in various breakdown processes in solid, liquid and gaseous insulating materials.
3. Know about generation and measurement of D. C., A.C., & Impulse voltages.
4. Know about H. V. testing of equipment and insulating materials, as per the standards.

UNIT- I (14 Hrs.)

Over Voltages in Electric Power Systems: Causes of over voltages and their effect onpower system – Lightning, switching surges and temporary over voltages-protection against over voltages.

Breakdown in Gases: Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharges.

Breakdown in liquid and solid Insulating materials: Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT- II (8 Hrs.)

Generation of High Voltages (7 Hours): Generation of high voltages, generation of high D.C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT- III (8 Hrs.)

Measurements of High Voltages and Currents: Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT- IV (10 Hrs.)

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories: Various standards for HV Testing of electrical apparatus, IS, IEC standards, testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and Some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Recommended Books

1. M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', McGraw Hill Education,
2. C.L. Wadhwa, 'High Voltage Engineering', New Age International Publishers, **2**
3. D.V. Razevig (Translated by Dr. M. P. Chourasia), 'High Voltage Engineering Fundamentals', Khanna Publishers,
4. E. Kuffel, W.S. Zaengl and J. Kuffel, 'High Voltage Engineering Fundamentals', Newnes Publication,

5. R. Arora and W. Mosch, 'High Voltage and Electrical Insulation Engineering', JohnWiley & Sons,

6. Various IS standards for HV Laboratory Techniques and Testing.

SUBJECT TITLE: POWER SYSTEM ANALYSIS AND DESIGN LAB.

SUBJECT CODE: PSAP-308

SEMESTER: 8
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
0	0	2	1

Internal Assessment: 60

End Term Exam: 40

LIST OF EXPERIMENTS

1. Introduction to software tools for power system studies like MiPower, Etap etc. and/or some high level programming language such as MATLAB, C++ etc.
2. Design of transmission system for given power and distance.
3. Design of distribution systems.
4. Design of underground cables for a substation.
5. To develop a program for formation of Bus Admittance Matrix.
6. To develop a program for load flow analysis by Gauss Seidal method.
7. To develop a program for load flow analysis by Newton Raphson method.
8. To develop a program for formation of Bus Impedance Matrix using building algorithm.
9. To calculate short circuit currents and circuit breaker ratings for a power system network.
10. To develop a program for economic load dispatch of power systems.
11. Power system stability studies on a single machine system.
12. Optimal Capacitor placement on a system having variable reactive power and low voltage profile.
13. To develop a SIMULINK model for Load Frequency Control of single area system without and with PI Controller.

Note: At least ten experiments must be performed from the given list

SUBJECT TITLE: ELECTRICAL MACHINE DESIGN

SUBJECT CODE: EMDL-308

SEMESTER: 8
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines.
2. To design single and three phase transformer.
3. To design three phase induction motor and synchronous machine.

Course Outcomes:

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

1. To analyze general considerations for design of electrical machines
2. To understand concepts of design of transformer.
3. To design three phase induction motor and synchronous machine.

UNIT-I

Introduction: Review of electrical properties of insulating materials and magnetic circuits, Major considerations in electrical machine design, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, methods of ventilations, rating of machines, Limitations (assumptions) of traditional designs and need of Computer Aided Design.

UNIT-II

Transformers: General considerations, Sizing of a transformer, main dimensions, Kva output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT-III

Three Phase Induction Motor: Standard specifications, Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines,

design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT-IV

Synchronous Machine: Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Recommended Books

1. A.K. Sawhney, 'A Course in Electrical Machine Design', Dhanpat Rai and Sons, **1970**.
2. M.G. Say, 'Theory & Performance & Design of A.C. Machines', ELBS London.
3. S.K. Sen, 'Principles of Electrical Machine Design with Computer Programmes', Oxfordand IBH Publishing, **2006**.

SUBJECT TITLE: HVDC TRANSMISSION

SUBJECT CODE: HVTL-308

SEMESTER: 8
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To introduce to the advantages of HVDC transmission over HVAC transmission.
2. To understand the operation of Line Commutated Converters and Voltage Source Converters. and the control strategies used in HVDC transmission system.
3. To study HVDC related effects such as; corona, interference and harmonics.
4. To study the effect of HVDC control on power system stability.

Course Outcomes:

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

1. To know the importance of HVDC transmission.
2. To understand HVDC system control strategies.
3. To understand the enhancement of power system stability by HVDC system.

UNIT-I (5 Hrs.)

Overview: Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission.

UNIT-II (15 Hrs.)

HVDC System: Configurations of DC transmission system, planning for High Voltage Direct Current (HVDC) transmission, Introduction to Device: Thyristor valve, valve tests, recent trends.

Converter and HVDC System Control: Converter configurations and their characteristics, Types of HVDC links, Pulse number, choice of converter configuration, simplified analysis of

Graetz circuit, converter bridge characteristics, characteristics of a twelve-pulse converter, detailed analysis of converters with and without overlap.

UNIT-III (12 Hrs.)

Corona and Interference: Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference.

Harmonic Filters: Generation of harmonics, Smoothing reactor, design of AC filters, DC filters, protection against over-currents, over-voltages in a converter station, surge arresters, Parallel operation of HVDC/AC systems, Multi terminal systems.

UNIT- IV (8 Hrs.)

Stability Enhancement using HVDC Control: Basic Concepts: Power System Angular,Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

Recommended Books

1. K.R. Padiyar, 'HVDC Power Transmission Systems', New Age International Publishers, **2011**.
2. J. Arrillaga, 'High Voltage Direct Current Transmission', Peter Peregrinus Ltd., **1983**.
3. E.W. Kimbark, 'Direct Current Transmission', Vol.1, Wiley Interscience, **1971**.
4. S. Kamakshaiah and V. Kamaraju, 'HVDC Transmission', McGraw Hill Education, **2017**.

SUBJECT TITLE: FUZZY LOGIC SYSTEMS

SUBJECT CODE: FLSL-308

SEMESTER: 8

CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To introduce to classical sets and fuzzy sets.
2. To study about classical relations and fuzzy relations.
3. To learn about membership functions and fuzzy arithmetic.

Course Outcomes:

1. Familiarity with classical sets and fuzzy sets.
2. Awareness about classical relations and fuzzy relations.
3. Knowledge about membership functions and fuzzy arithmetic.

UNIT I (10 Hrs.)

Introduction, Classical Sets and Fuzzy Sets: Background, Uncertainty and Imprecision, Statistics and Random Processes, Uncertainty in Information, Fuzzy Sets and Membership, Chance versus Ambiguity. Classical Sets - Operations on Classical Sets, Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions Fuzzy Sets - Fuzzy Set operations, Properties of Fuzzy Sets.

UNIT II (14 Hrs.)

Classical Relations and Fuzzy Relations: Cartesian Product, Crisp Relations, Cardinality of Crisp Relations, Operations on Crisp Relations, Properties of Crisp Relations, Composition. Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Non-interactive Fuzzy Sets. Tolerance and Equivalence Relations, Crisp Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations. Value Assignments, Cosine Amplitude, Max-min Method.

UNIT-III (6 Hrs.)

Membership Functions: Features of the Membership Function, Standard Forms and Boundaries, Fuzzification, Membership Value Assignments, Intuition, Inference, Rank Ordering, Angular Fuzzy Sets.

UNIT-IV (10 Hrs.)

Fuzzy-to-Crisp Conversions, Fuzzy Arithmetic: Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification Methods Extension Principle, Crisp Functions, Mapping and Relations, Functions of fuzzy Sets, Extension Principle, Fuzzy Transform (Mapping), Practical Considerations, Fuzzy Numbers, Interval Analysis in Arithmetic.

Recommended Books

1. G. Klir, B. Juan, 'Fuzzy Sets and Fuzzy Logic', Prentice Hall, New Jersey,
2. V. Novák, Základy Fuzzy Modelování. Praha: BEN, 2000. 176 p. ISBN 80-7300-009-1.
3. P. Klement, 'Triangular Norms', Kluwer Academic Press, London,
4. H.T. Nguyan, E A. Walker, 'Fuzzy Logic', Chapman and Hall, New York,
5. S.N. Sivanandam, and S.N. Deepa, 'Principles of Soft Computing', Wiley Publications,

SUBJECT TITLE: NEURAL NETWORKS

SUBJECT CODE: NNWL-308

SEMESTER: 8
CONTACT HOURS/WEEK:

Lecture (L)	Tutorial (T)	Practical (P)	Credit (C)
3	1	0	4

Internal Assessment: 40

End Term Exam: 60

Duration of Exam: 3 Hrs

Learning Objectives:

1. To introduce to artificial neural networks and their applications.
2. To introduce to learning processes involved in training of neural networks
3. To learn about single-layer and multi-layer perceptron and self-organization maps.

Course Outcomes:

1. Familiarity with artificial neural networks and their applications.
2. Learning about training of neural networks.
3. Knowledge about single-layer and multi-layer perceptron and self-organization maps.

UNIT-I (10 Hrs.)

Introduction: what is a neural network? Human Brain, Models of a Neuron, Neuralnetworks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

Learning Process-1: Error Correction learning, Memory based learning, Hebbian learning.

UNIT-II (10 Hrs.)

Learning Process-2: Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process.

Single Layer Perceptrons: Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perception, convergence theorem.

UNIT-III (10 Hrs.)

Multilayer Perceptron: Back propagation algorithm XOR problem, Heuristics, Output representation and decision rule, Computer experiment, feature detection, back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.

UNIT-IV (10 Hrs.)

Self-Organization Maps: Two basic feature mapping models, Self-organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization,

Adaptive patter classification, Hierarchal Vector quantilizer, contexmel Maps. HOPFIELD MODELS – Hopfield models.

Recommended Books

1. B. Vegnanarayana, 'Artificial Neural Networks', Prentice Hall of India P. Ltd.
2. Li Min Fu,' Neural networks in Computer Intelligence', TMH,
3. James A. Freeman and David M.S. Kapura, 'Neural Networks', Pearson Education
4. N.P. Padhy, 'Artificial Intelligence and Intelligent Systems', Oxford University Press,New Delhi,.
5. S.N. Sivanandam and S.N. Deepa, 'Principles of Soft Computing', Wiley Publications,