ELECTRICAL CIRCUITS and NETWORKS

General Course Information:

Course Code: PCC-EE201-T Course Credits: 4.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 1 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Recall the fundamental of network theorems	**L1(Remembering)**
CO2.	Understand and derive the response of electrical circuits and characteristics and parameters of two port networks	**L2(Understanding)**
CO3.	Apply the knowledge of network analysis in technical problen solving	**L3(Applying)**
CO4.	Perform analysis and synthesis of two port networks applicabl in various engineering problems	**L4(Analyzing)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT- I

Network topology and theorems: Classification of circuits, sources and signals, standard signals, source transformations, Network topology, graph matrices, formulation and solution of circuit equations based on graph theory using different analysis techniques- circuit, cut set and mixed. Concept of duality, Network theorems and their applications- Superposition, reciprocity, Thevenin, Norton, Maximum power transfer, Millman, Substitution, Compensation and Tellegan's theorem.

UNIT- II

Transient response: Introduction to non-linear circuits and their analysis, Analysis of circuits with dependent sources, Transient response under d.c. and a.c. excitation, Analysis of

magnetically coupled circuits, Series and parallel resonance circuits, bandwidth and Q-factor, response with variation in parameters and frequency.

UNIT- III

Two-port networks and Parameters: Concept of one port, two-port networks, characteristics and parameters(impedance parameters, admittance parameters, transmission parameters and hybrid parameters), interrelationships of parameters, image & iterative impedance, concept of characteristic impedance, scattering parameters, insertion loss, interconnection of two-port networks, analysis of terminated two-port networks, extensions to multiport networks.

UNIT- IV

Network functions and Synthesis: Generalized network functions (Driving point and Transfer), concepts of poles and zeros, determination of free and forced response from poles and zeros, concept of minimum phase networks, analysis of ladder, lattice, T and bridged-T networks, Network synthesis- Synthesis problem formulation, properties of positive real functions, Hurwitz polynomials, properties of RC, LC and RL driving point functions, Foster and Cauer synthesis of LC and RC circuits.

REFERENCES:

1. M.E. Vanvalkenburg, "Network Analysis", PHI, 3rd Edition, 2014.
2. Franklin F. Kuo, "Network Analysis and Synthesis", 2nd Edition, Wiley India Ltd., 2006
3. S. P. Ghosh, A.K. Chakraborthy, "Network Analysis and Synthesis" McGraw Hill, 2010
4. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1988.
5. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", 9th Edition, McGraw Hill Education, 2018.

Course Articulation Matrix:

Course/Course Code: Electrical Circuits and Networks (PCC-EE201-T),															Semester: III
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	1	-	-	2	3	2	2
CO2	3	3	2	1	1	-	-	-	1	-	-	2	2	2	1
CO3	3	3	2	2	2	-	-	-	1	-	-	2	2	3	1
CO4	3	3	2	2	2	-	-	-	1	-	-	2	2	3	1

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3-** Substantial/High

ELECTRONIC DEVICES AND CIRCUITS

General Course Information:

Course Code: **PCC-EE203-T** Course Credits: 3.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Outline semiconductors, diodes, transistors, operational amplifiers and digital circuits	**L1 (Remembering**
CO2.	Explain about different power amplifier circuits, their design and use in electronics and communication circuits	**L2 (Understanding**
CO3.	Demonstrate and interpret the working of analog and digital electronic devices and circuits	**L3 (Applying)**
CO4.	Distinguish between various logic families and their characteristics	**L4 (Analyzing)**
CO5.	Design and implement analog, combinational and sequential logic circuits applicable in various engineering problems	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Contents

UNIT-I

Diode and Transistor biasing circuits: P-N junction diode, I-V characteristics of a diode, Zener diodes, clamping and clipping circuits, Transistor biasing circuits: Base bias, Emitter-feedback bias, collector-feedback bias, Voltage divider bias, emitter bias, CE, CC and CB analysis, h-parameters, JFET: Gate bias, Self bias, Voltage-divider bias and source bias, current source bias, CS, CD and CG amplifier, MOSFET: Depletion type, Enhancement type and their biasing, Power Amplifiers: Class A, B, C, D and S power amplifiers, Push-pull operation.

UNIT-II

OP-AMP: Differential amplifier and its DC, AC analysis, OP-AMP characteristics, Non-Inverting/Inverting Voltage and Current feedback, Linear and Non-Linear OP-AMP circuits, Regulated power supplies**.**

Oscillators- Barkhausen criteria of oscillations, Wein-bridge, RC oscillator, 555 timer: its monostable and astable operation.

UNIT-III

Logic gates and Boolean Algebra: Logic gates, Universal gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic

Logic Families: transistor as a switching element, Tri-state switch, Bipolar logic Families: RTL, DTL, TTL, ECL, IIL, MOS Logic families: NMOS, CMOS families and characteristics, various logic functions and their implementation.

UNIT-IV

Combinational Circuits: Introduction to combinational circuits, arithmetic and logical operation, design of Half adder & full adder, subtractor circuits, decoders, multiplexers, demultiplexers, comparators, Sequential Circuits: Flip-flops, bistable circuits: RS, JK, D, T, Master/Slave Flip-flop, race around condition, latches, synchronous and asynchronous counters up & down counters, shift Registers.

REFERENCES:

1. J. Millman, C. Halkias and C. D. Parikh, "Integrated Electronics", McGraw Hill, 2nd edition 2017
2. R. Boylested and L. Nashelsky, "Electronics Devices and Circuit Theory", Pearson New International, 11th edition, 2013
3. J. Millman, C. Halkias and S. Jit, "Electronics Devices and Circuits", TMH 4th edition, 2015.
4. A. Malvino and D. Bates, "Electronic Principles", TMH 8th edition, 2016
5. D. Leach, A. Malvino, G. Saha, "Digital Principles and Applications", TMH education, 7th edition, 2010
6. C. H. Roth, L. L. Kinney, "Fundamentals of Logic Design", Cenegae learning, 7th edition, 2013
7. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 4th edition 2016.

Course Articulation Matrix:

Course/Course Code: Electronic Devices and Circuits (PCC-EE203-T),														Semester: III	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	-	-	-	2	1	-	2	2	3	2
CO2	3	3	2	1	1	-	-	-	1	-	-	2	2	2	1
CO3	3	3	2	2	2	-	-	-	1	-	-	2	2	3	1
CO4	3	3	2	2	2	-	-	-	1	2	-	2	2	3	1
CO5	2	2	3	2	1	1	-	-	2	1	1	2	2	2	1

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3-** Substantial/High

ELECTRIC MACHINES-I

General Course Information:

Course Code: PCC-EE205-T Course Credits: 4.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 1 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Recall the basics of electric machines	**L1(Remembering)**
CO2.	Describe the performance of different types of electric machines.	**L2(Understanding)**
CO3.	Solve the problems related with electric machines.	**L3(Apply)**
CO4.	Compare the performance characteristics of electric machines.	**H1(Analysis)**
CO5.	Judge and use the machines on the basis of their utilization and performance.	**H2 (Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Level**

Course Content

UNIT-I

Electromechanical Energy Conversion and Single Phase Transformer: Energy in a magnetic systems, field energy and mechanical force, energy in singly and multiply excited magnetic systems. Transformer construction, theory and operation, E.M.F. equation, Ideal and practical trans former, exact and approximate equivalent circuits, no load and on load operation, phasor diagrams, power and energy efficiency, open and short circuit tests, back to back test, voltage regulation, effect of load on power factor, Per Unit transformer values, excitation phenomenon in transformers, Auto transformers (construction, working & applications),

UNIT-II

Three Phase and Other Transformers

Constructional features of three phase transformers, Cooling methodology, parallel operation of single phase and three phase transformers, three phase transformer connections, phasor groups, three phase to two phase and six phase conversion. Three winding transformers and its equivalent circuit, Tap changing of transformers, tertiary winding, Applications. Variable frequency transformer, voltage and current transformers, Grounding transformer, welding transformers, Pulse transformer and applications.

UNIT-III

DC Generators: Construction, working and types of dc generator, EMF equation, lap & wave winding, distributed & concentrated windings, armature reaction, commutation, interpoles and compensating windings, characteristics of dc generators, voltage build up, Parallel operation of DC generators, Applications.

UNIT-IV

D.C. Motors: Principles of working, Significance of back emf, Torque Equation, Types and Characteristics of DC Motors, Need of Starter, three point starter, four point starter, Speed Control (armature resistance, flux control, armature voltage, Thyrisor), Ward-Leonard system, Swinburne's test, Hopkinson's test, braking of dc motor (regenerative, Dynamic, Plugging), Losses and Efficiency, Effect of saturation and armature reaction on losses; Applications.

REFERENCES:

1. I.J. Nagarath and D.P. Kothari, "Electric Machines", T.M.H. Publishing Co Ltd., New Delhi, 4th Edition 2010.
2. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications.
3. J. B. Gupta., "Theory and Performance of Electrical Machines", Kataria and Sons, 14th edition 2009.
4. Fitzgerald Kingsley and Umans, "Electric Machinery" McGraw HillBooks co., New Delhi, 7th Edition, 2013.
5. A.S.Langsdorf, "Theory of AC Machinery", Tata McGraw Hill.
6. B. L. Thareja, "A Text Book of Electrical Technology", Volume II, S. Chand Publications.
7. Ashfaq Husain, "Electrical Machines", Dhanpat Rai Publications.

Course Articulation Matrix:

Course/Course Code: Electric Machine-I (PCC-EE205-T)												Semester: III			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	1	1
CO2	3	2	2	2	2	1	-	-	-	-	-	1	2	2	1
CO3	3	3	2	1	1	-	-	-	1	-	-	1	3	3	1
CO4	3	2	2	2	1	-	-	-	1	-	1	2	2	3	1
CO5	3	2	2	1	-	1	-	2	-	2	3	2	2	2	2

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3**- Substantial/High

GENERATION OF ELECTRIC POWER

General Course Information:

Course Code: PCC-EE207-T Course Credits: 4.0 Mode: Lecture (L) Type: Program Core Teaching Schedule L T P: 3 1 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.	**L1(Remembering)**
CO2.	Summarize the working and layout of steam power plants and discuss about its economic and safety impacts.	**L2(Understanding)**
CO3.	Illustrate the working principle and basic components of the nuclear power plant, diesel engine and the economic and safety principles involved with it.	**L3(Apply)**
CO4.	Examine the mathematical and working principles of different electrical equipment's involved in the generation of power.	**L4(Analysis)**
CO5.	Evaluate the different power generating systems	**L5(Evaluating)**
CO6.	Construct the model on the applications basis of power plant	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT- I

Load and loading forecasting: Load curves, maximum demand, load factor, diversity factor, capacity factor, utilization factor, types of load, load forecasting.

Power plant economics: Choice of type of generation, size of generator and number of units, cost of electrical energy, depreciation of plant, effect of load factor on cost of electrical energy.

UNIT- II

Thermal power plants: Choice of site, main and auxiliary equipment fuel gas flow diagram, water stream flow diagram, working of power plants and their layout, characteristics of turbo generators.

Hydroelectric plants: Choice of site, classification of hydroelectric plants, main parts and working of plants and their layouts, characteristics of hydro electric generators.

UNIT- III

Nuclear power plants: Choice of site, classification of plants, main parts, layout and their working, associated problems.

Diesel power plants: Diesel plant equipment, diesel plant layout and its working, application of diesel plants.

UNIT- IV

Combined working of plants: Advantages of combined operation plant requirements for base load and peak load operation. Combined working of run off river plant and steam plant.

Tariffs and power factor improvement: Different types of tariffs and methods of power factor improvement.

REFERENCES:

1. P.K. Nag, "Power Plant Engineering", Tata McGraw Hill.
2. F.T. Morse, "Power Plant Engineering", Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
3. Kothari & Nagrath, "Power System Engineering", McGraw Hill.
4. Granger and Stevenson, "Power System Analysis", McGraw Hill.
5. Electric Power Generation operation and control, Wood and Wollenberg, Willey.
6. R.K. Rajput, Power System Engineering, Laxmi Publication.

Course Articulation Matrix:

Course/Course Code: Generation of Electric Power(PCC-EE207-T),														Semester: III
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	2	1	1	-	-	-	2	2	2	2	1
CO2	3	2	3	2	2	2	1	-	-	-	2	3	3	2	1
CO3	3	3	3	2	2	2	1	-	-	-	2	3	3	3	1
CO4	3	2	3	3	2	2	1	-	-	-	2	1	2	2	1
CO5	2	2	3	2	2	2	1	-	-	-	2	2	2	2	1
CO6	3	3	3	2	2	2	1	-	-	-	2	3	2	2	1

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3**- Substantial/High

MATHEMATICS-III

General Course Information	
Course Code: BSC201-T Course Credit: 3	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks), and end semester examination of 70 marks.
Contact Hours: 3/week, (L-T-P:3-0-0) Mode: Lectures Examination Duration: 3 Hours	For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

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

CO1. **Define** concepts and terminology of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing. (LOTS: Level 1: Remember)
CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)
CO3. **Apply** mathematical principles to solve computational problems. (LOTS: Level 3: Apply)
CO4. **Compare** various probability distributions (HOTS: Level 4: Analyse).
CO5. **Select** suitable hypothesis testing methods for given problems and interpret the respective outcomes. (HOTS: Level 4: Evaluate)
CO6. **Integrate** the knowledge of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing for solving real world problems. (HOTS: Level 6: Create)

UNIT- I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosine series.

UNIT-II

Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac delta function.

UNIT-III

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity. Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions.

UNIT-IV

Complex integral, Cauchy Gaursat theorem (without proof), Cauchy integral formula (without proof), Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes and singularities of complex functions, Residues. Evaluation of real integrals using residues (around unit and semi-circle only).

Text and Reference Books:

1. F. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2015.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 1965.
3. R. K. Jain, S.R.K. Iyenger. *Advance Engineering. Mathematics*, 4th edition, Narosa Publishing House, 2012.
4. Michael D. Greenberg, *Advanced Engineering Mathematics*, 2nd edition, Pearson Education, 2002.
5. Johnson and Miller *Probability and statistics for Engineers*, 8th edition, Pearson Education India, 2015.

CO-PO Articulation Matrix Mathematics-III (BSC201-T)

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1. **Define** concepts and terminology of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing. (LOTS: Level 1: Remember)	**1**	**--**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**
CO3. **Apply** mathematical principles to solve computational problems. (LOTS: Level 3: Apply)	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
CO4. **Compare** various probability distributions (HOTS: Level 4: Analyse).	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
CO5. **Select** suitable hypothesis testing methods for given problems and interpret the respective outcomes. (HOTS: Level 4: Evaluate)	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
CO6. **Integrate** the knowledge of Fourier series and Fourier transforms, Functions of complex variables, Power Series and, Probability distributions and hypothesis testing for solving real world problems. (HOTS: Level 6: Create)	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**

ELECTRONIC DEVICES AND CIRCUITS LABORATORY

General Course Information:

Course Code: **PCC-EE203-P** Course Credits: 1 Mode: Practical Type: Program Core Contact Hours: 2 hours per week. Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

Course Outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT Level
CO1.	Memorize the characteristics of semiconductors, diodes, transistors, operational amplifiers and digital circuits	**L1 (Remembering)**
CO2.	Perform and learn about different power amplifier circuits, their design and use in electronics and communication circuits	**L2 (Understanding)**
CO3.	Demonstrate and interpret the working of analog and digital electronic devices and circuits	**L3 (Apply)**
CO4.	Analyze various logic families and their characteristics, combinational and sequential logic circuits	**L4 (Analyzing)**
CO5.	Design and implement analog, combinational and sequential logic circuits applicable in various engineering problems	**L6 (Creating)**

LIST OF EXPERIMENTS:

1. To observe the performance of
   (a) Common emitter amplifier (b) Common base amplifier (c) common collector amplifiers
2. To study the characteristic of BJT (NPN, PNP), JFET (N-channel, P-channel), MOSFET (N-channel, P-channel).
3. To study the following mathematical operations using Op-amps:-
   (a) Addition (b) Subtraction (c) Multiplication (d) Division (e) Integration (f) Differentiation
4. To study the Op-amp as:
   (a) Astable multivibrator (b) Mono-stable multivibrator (c) Schmitt Trigger cicuit
5. To study OP-AMP as non-inverting voltage amplifier, low pass filter, high-pass filter and bandpass filter
6. To study the characteristics of Wein-bridge, RC oscillator .
7. To study NOT, AND, OR, NOR, XOR, XNOR gates.
8. To study and verify the truth table of R-S, D, J-K and T flip flop
9. To verify the operation of a 4 bit UP and DOWN serial/parallel counter
10. Study of a combinational circuit of half adder, full adder, subtractor, encoder, decoder, multiplexer and 4 bit digital comparator.
11. Study of shift register SISO, SIPO, PISO, PIPO using shift register.

NOTE: At least eight experiments are to be performed in the semester, out of which at-least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

ELECTRICAL MACHINES-I LABORATORY

General Course Information:

Course Code: PCC-EE205-P Course Credits: 1.5 Mode: Practical Type: Program Core Contact Hours: 3 hours per week. Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

Course Outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Memorize the basics of electric machines like: transformer, DC machine and electromechanical energy conversion principle	**L1(Remembering)**
CO2.	Discuss about different characteristics and working design of electric machines.	**L2(Understanding)**
CO3.	Demonstrate and interpret the working of electric machines at different operational conditions.	**L3(Apply)**
CO4.	Examine and analyze various performance characteristics of electric machines.	**H1(Analysis)**
CO5.	Select the electrical machines with ratings on the basis of their utilization and performance.	**H2 (Evaluating)**
CO6.	Design machine models for various engineering problems	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Level**

List of Experiments

1. To find turns ratio & polarity of a 1-phase transformer.
2. To perform open & short circuit tests on a 1-phase transformer.
3. To perform Sumpner's Back to back test on 1-phase transformers.
4. Parallel operation of two 1-phase transformers.
5. To convert three phase to 2-phase By Scott-connection.
6. To perform load test on DC shunt generator.
7. To perform load test on DC series generator.
8. To obtain magnetization characteristics of separately excited DC Machine.
9. To obtain magnetization characteristics of self-excited DC Machine.
10. Speed control of DC shunt motor.
11. Swinburne's test of DC shunt motor.
12. Hopkinson's test of DC shunt M/Cs.
13. Fields test on two identical D.C. series machines
14. Ward Leonard method of speed control.

NOTE: At least eight experiments are to be performed in the semester, out of which at-least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

ELECTRICAL WORKSHOP

General Course Information:

Course Code: **PCC-EE209-P** Course Credits: 1 Mode: Practical Type: Program Core Contact Hours: 2 hours per week. Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

Course Outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Memorize the knowledge about various tools, electrical material and symbols.	**L1 (Remembering)**
CO2.	Discuss various types of wiring systems, wiring tools, lighting & wiring accessories, wiring estimation & costing, etc.	**L2 (Understanding)**
CO3.	Use the electrical tools in real life.	**L3 (Apply)**
CO4.	Examine and estimate the basic requirements for wirings.	**L4 (Analyzing)**
CO5.	Understand modern manufacturing operations, including their capabilities, limitations, and how to design a model economically	**L6(Creating)**

LIST OF EXPERIMENTS:

1. To study of different type of tools, Electrical Material, Symbols and Abbreviations.
2. To study different types of wiring & Practices of Staircase, Corridor & Godown wiring
3. To study & Perform Fluorescent, Tube light, CFL, LED & its series and parallel Connections.
4. To study & Perform Circuit of SMPS.
5. To study moving iron, moving coil, Electrodynamics and induction type meter.
6. To study various types of wires/ cables and practices of switches.
7. To study importance of earthing and measurement of earth resistance.
8. Trouble earth resistance shooting of equipment like fan, iron, mixer, grinder.
9. To study various types of Transformers and assembling practices of transformers.
10. Different fuses, SFU, MCB, ELCB, MCCB.
11. Design of solar system for small houses.
12. To study & calibrate single phase energy meter.
13. To study & Perform Circuit of home inverter.

NOTE: At least eight experiments are to be performed in the semester, out of which at-least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

POWER ELECTRONICS

General Course Information:

Course Code: PCC-EE202-T Course Credits: 3.0 Mode: Lecture (L) Type: Program Core Teaching Schedule L T P: 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Recall the fundamental of electronics devices and circuit	**L1(Remembering)**
CO2.	Describe various power semiconductor devices, passive components and switching circuits.	**L2(Understanding)**
CO3.	Deploy power converter circuits design and learn to select suitable power electronic devices by assessing the requirements of application fields.	**L3(Apply)**
CO4.	Compare, formulate and analyze a power electronic circuit design and assess the performance.	**L4(Analysis)**
CO5.	Estimate the critical areas for improvement in an industries and derive typical alternative solution.	**L5(Evaluating)**
CO6.	Design a suitable power converters to control Electrical Motors and other industry grade apparatus	**L6(Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT- I

Modern Power Electronics Devices: Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, Two transistor analogy, Protection of SCR, Commutation circuits, SCR ratings, Triggering Methods, Series and Parallel operation of SCR.

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

UNIT- II

Single-phase Converter: Half wave converter, 2-pulse midpoint converter, half controlled and fully controlled bridge converters, input current and output voltage waveforms, effect of load and source impedance, expressions for output voltage, effect of free-wheeling diode, triggering circuits, Dual converter.

Three-phase Converter: Half wave, full wave, half controlled and fully controlled bridge converters, effect of load and source impedance, expressions for output voltage, Dual Converter.

UNIT- III

Inverters: Classification, basic series and improved series inverter, parallel inverter, single phase and three phase voltage source inverter, 120 degree mode and 180 degree mode conduction schemes, modified McMurray half bridge and full bridge inverters, McMurray -Bedford half bridge and full bridge inverters, brief description of parallel and series inverters, current source inverter (CSI), transistor and MOSFET based inverters

UNIT- IV

AC Voltage Controllers & Regulators: Single phase and three phase ac voltage controllers with R, RL and RLE loads, Single phase two SCR's in anti-parallel with R and RL loads, Voltage control, Operation waveforms, Types of voltage regulator, equation of load current, output voltage equation, synchronous tap changer, three phase regulator.

Cyclo-converter: Principle of operation of cyclo-converter, non-circulating and circulating types of cyclo-converters. Waveforms, control technique**.**

REFERENCES:

1. M. Ramamoorthy, "Thyristor and their applications", East West Publication, 1991.
2. P.S. Bimbhra, "Power Electronics", Khanna Publishers, 2015.
3. MD Singh and KB Khanchandani, "Power Electronics", TMH Edition, 2007.
4. AK Gupta and LP Singh, "Power Electronics", Dhanpat Rai Publishing Co.
5. G.K. Dubey, S. R. Doradla, A. Joshi, and R. M. K. Sinha, "Thyristorised Power Controllers", New Age International Private Ltd.
6. Mohan N., Undeland T. M. and Robbins W. P., "Power Electronics Converters, Applications and Design", 3rd ED, Wiley India.

Course Articulation Matrix:

Course/Course Code: Power Electronics (PCC-EE202-T),														Semester: IV
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	1	-	-	-	2	2	3	3	1
CO2	3	2	3	3	2	2	1	-	-	-	2	2	3	2	1
CO3	2	3	3	2	2	2	1	-	-	-	2	2	3	2	1
CO4	3	2	2	2	3	3	1	-	-	-	3	2	2	1	1
CO5	2	2	2	3	2	2	1	-	-	-	1	1	3	2	1
CO6	3	3	3	2	2	2	1	-	-	-	2	2	3	2	1

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3**- Substantial/High

ELECTRICAL MACHINES-II

General Course Information:

Course Code: PCC-EE204-T Course Credits: 4.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 1 0 Examination Duration: 3 hours	Course Assessment Methods (Internal: 30; External: 70) Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments and quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Recall the basics of electric machines	**L1(Remembering)**
CO2.	Illustrate the performance of different types of rotating electric machines.	**L2(Understanding)**
CO3.	Solve the problems related with rotating electric machines.	**L3(Apply)**
CO4.	Compare the performance characteristics of rotating electric machines.	**H1(Analysis)**
CO5.	Judge and use the rotating electric machines on the basis of their utilization and performance.	**H2 (Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Level**

Course Content

UNIT-I

Poly Phase Induction Motors: Construction details of three-phase induction motor, Rotating magnetic field, principle of operation, slip, Induction motor as generalized transformer-Equivalent circuit, expression for torque, full load torque, maximum torque, starting torque and output power, torque-slip and torque-speed characteristics, no load and blocked rotor test, circle diagram, introduction to deep bar cage and double cage induction motor, starting of induction motors, speed control of induction motor, cogging &crawling, Applications.

UNIT-II

Synchronous Generators: Alternators: Construction features and types, EMF equation of alternators, armature reaction in alternators, Alternator on load, Synchronous reactance, Synchronous Impedance, Voltage regulation, Determination of voltage regulation using EMF, MMF methods, ZPF, Ampere Turn methods and Potier Triangle, Synchronizing and parallel operation of alternators, Salient pole synchronous machine, two-reaction theory, slip test, Applications.

UNIT-III

Synchronous Motor: Principle of operation, Methods of starting, Torque and power equations, Synchronous motor on load, Synchronous motor on constant excitation variable load, Synchronous motor on constant load variable excitation, 'V' and inverted 'V' curves, Synchronous condenser, Hunting and its suppression, Behaviour of synchronous machine on short circuit, capability curves, Applications.

UNIT-IV

Single Phase Induction & Special Motors: Single Phase Induction Motor, Double revolving field theory, Stepper Motor, Brushless DC motor, Servomotors, Shaded Pole Motor, Reluctance Motor, Hysteresis Motor, Single Phase Series Motor, Repulsion Motor, Schrage Motor, Linear Induction Motor.

REFERENCES:

1. I.J. Nagarath and D.P. Kothari, "Electric Machines", T.M.H. Publishing Co Ltd., New Delhi, 4th Edition 2010.
2. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications.
3. J. B. Gupta., "Theory and Performance of Electrical Machines", Kataria and Sons, 14th edition 2009.
4. Fitzgerald Kingsley and Umans, "Electric Machinery" McGraw HillBooks co., New Delhi, 7th Edition, 2013.
5. A.S. Langsdorf, "Theory of AC Machinery", Tata McGraw Hill.
6. B. L. Thareja, "A Text Book of Electrical Technology", Volume II, S. Chand Publications
7. P.S. Bhimbra, "Generalized Theory of Electrical Machines", Khanna Publications.
8. Ashfaq Husain, "Electrical Machines", Dhanpat Rai Publications.

Course Articulation Matrix:

Course/Course Code: Electric Machine-II (PCC-EE204-T)														Semester: IV	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
CO2	3	1	2	2	-	-	-	-	1	-	-	1	2	2	1
CO3	2	3	2	1	-	-	-	-	1	-	-	-	3	3	1
CO4	3	2	2	2	1	-	-	-	-	-	1	2	2	3	1
CO5	3	2	2	1	-	1	1	2	-	2	3	2	2	2	2

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3**- Substantial/High

POWER SYSTEMS - I

General Course Information:

Course Code: **PCC-EE206-T** Course Credits: 4.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 1 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes:

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Draw the single line diagram and model the power system components for power system analysis	**L1(Remembering)**
CO2.	Understand the major components of Transmission and Distribution Systems, its modeling and important parameters	**L2(Understanding)**
CO3.	Investigate the performance of transmission lines by calculating voltage regulation and efficiency	**L3(Applying)**
CO4.	Analyze the mechanical and electrical design aspects of transmission system	**L4(Analyzing)**
CO5.	Compare between different supply systems, Overhead transmission lines and underground cables and select the appropriate according to the need.	**L5(Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT- I

Basic Concepts: Importance of electric power, single line diagram of power system, Modeling of power system components, Per unit system, Symmetrical and unsymmetrical components, Representation of generators, lines and transformers in sequence networks, Growth of power systems in India, power supply networks: effect of voltage on conductor size, comparison of conductor volume in typical supply systems, elementary high voltage DC transmission DC transmission and its advantages and disadvantages.

UNIT- II

Transmission line parameters: Calculations of resistance, inductance, and capacitance for single phase, three phase single circuit and double circuit lines, skin and proximity effect.

Performance of lines: Classification of lines as short, medium and long, representation and detailed performance analysis of these lines including ABCD parameters, Surge Impedance loading, Ferranti's effect, Power flow through a transmission line and power circle diagrams

UNIT- III

Mechanical considerations: Various types of line conductors, line supports, poles and towers, sag calculations, effect of wind, ice and temperature, stringing chart, sag template, line vibrations.
Insulators: various types of insulator, voltage distribution, string efficiency, methods of increasing string efficiency.
Corona: Phenomenon of corona, disruptive critical voltage, visual critical voltage, corona loss, radio interference.

UNIT- IV

Underground cables: Classification and construction, insulation resistance, capacitance, capacitance determination, power factor in cables, capacitance grading, use of inter sheaths, losses, heat dissipation and temperature rise in cables, current rating, Faults in cables, comparison with overhead lines
Distribution Systems: components – feeders, distributers, service mains, connections schemes of distribution, Introduction to distributed generation

REFERENCES:

1. C. L. Wadhwa, "Electrical Power Sytems", New Age Internationals, 7th edition, 2016.
2. I. J. Nagrath and D. P. Kothari "Power System Engineering". McGraw-Hill, 3rd Ed., 2019.
3. A. Chakrabarty, P. V. Gupta, M. L. Soni and U. S. Bhatnagar , "A Course in Electrical Power" Dhanpat Rai Pub. Co.(P) Ltd., 2008.
4. J.B.Gupta , "Power Systems", S.K. Kataria and sons, 2013.
5. B.R.Gupta , "Power System Analysis and Design", S. Chand, 7th edition, 2014.
6. B.M.Weedy, "Electric power system", John Wiley and sons.
7. S. N. Singh, "Electric Power Generation, Transmission and Distribution", PHI, 2nd edition, 2008.
8. L. M. Fualkenberry, W. Coffer, "Electrical Power Distribution and Transmission", Pearson Education, 1996.
9. S. K. Gupta, " Power System Engineering", Umesh Publications, 2009.

Course Articulation Matrix:

Course/Course Code: Power Systems- I (PCC-EE206-T),													Semester: IV		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	2	1	-	1	-	1	1	2	2	1
CO2	3	2	2	1	-	2	1	-	1	-	1	1	2	1	1
CO3	3	2	2	2	-	2	1	-	1	-	1	1	3	2	1
CO4	3	3	2	2	-	2	1	-	1	-	1	1	3	2	1
CO5	3	3	2	2	-	2	1	-	1	-	2	1	3	2	2

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3**- Substantial/High

FIELDS AND WAVES

General Course Information:

Course Code: PCC-EE208-T Course Credits: 4.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 1 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Recall the basics of coordinates(2 D & 3D)	**L1(Remembering)**
CO2.	Describe the electromagnetic waves and theory.	**L2(Understanding)**
CO3.	Solve the problems related with electromagnetic waves and theory.	**L3(Apply)**
CO4.	Compare the performance of electromagnetic waves on the basis of different theories.	**H1(Analysis)**
CO5.	Judge the characteristics of electromagnetic waves and utilize them as per their requirements.	**H2 (Evaluating)**

***Revised Bloom's Taxonomy Action verbs/Level**

Course Content

UNIT-I

Introduction of Coordinates: Cartesian coordinates, cylindrical coordinates, spherical coordinates, Vector calculus: Differential length, area and volume, line surface and volume integrals and their significance, Del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stoke's theorem

UNIT-II

Electrostatics: Electrostatic fields, Field intensity, Electric flux density, Coulomb's Law, Electric field and potential due to point, line, plane and charge distribution, Gausses's Law and application, Electric field in material space: Properties of materials, conductors, dielectric constants, Effect of dielectric medium, continuity equation, boundary condition. Poission's and Laplace's equations, Equipotential Surfaces, Uniqueness Theorem, capacitance, method of images.

UNIT-III

Magnetostatics: Magneto-static fields, Magnetic flux density, Magnetic field Intensity, Biot-Savart's Law, Ampere's circuit law ,Faraday Law of Induction, application of ampere's law, - Maxwell's equation, Maxwell's equation for static fields, for harmonically varying fields, for free space, magnetic vector potential. Lorentz Force, magnetization in materials, magnetic boundary conditions, Self and mutual inductances, Relation between E and H.

UNIT-IV

Electromagnetic Waves: Polarization, Reflection of plane wave for perfect conductor, perfect dielectric at normal incidence as well as oblique incidence, Electromagnetic wave propagation, Depth of

Penetration, Brewester's Angle Poynting Theorem and interpretation of Poynting vector. **Transmission lines:** Transmission line parameters, Transmission line equations, input impedance, Characteristic Impedance, Reflection Coefficient, Standing wave ratio, Smith chart and its application.

REFERENCES:

1. M. N. O. Sadiku, "Elements of Electromagnetic", 4th Ed, Oxford University Press.
2. K.D. Prasad, "Electromagnetic Fields and Waves", Satya Prakashan, New Delhi.
3. Balmein and Jordan, "Electromagnetic Waves and Radiating System", PHI Publication.
4. W. H. Hayt and J. A. Buck, "Electromagnetic field theory", 7th edition TMH Publications.
5. R. Gowri, "Electromagnetic Field and Waves", Katson Publications.
6. J.D.F. Krauss, "Electromagnetics", McGraw Hill Publications.

Course Articulation Matrix:

Course/Course Code: Fields and Waves (PCC-EE208-T)										Semester: IV					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	-	-	-	-	-	-	1	3	1	1
CO2	3	1	1	1	-	-	-	-	1	-	-	1	2	2	-
CO3	2	3	2	1	-	-	-	-	1	-	-	-	3	3	1
CO4	3	2	1	2	1	-	-	-	-	-	1	2	2	3	1
CO5	3	1	2	1	-	1	1	2	-	2	3	2	2	1	1

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3-** Substantial/High

SIGNALS AND SYSTEMS

General Course Information:

Course Code: **PCC-EE210-T** Course Credits: 3.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course outcomes:

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT* Level
CO 1	Describe various signals and their behaviour involved in processing**.**	**L1 (Remembering)**
CO 2	Classify different systems used for signal processing and operation and Conceptualize the effects of sampling a CT signal	**L2 (Understanding)**
CO 3	Demonstrate the Conversion of signals in analog domain to digital domain using various transforms	**L3 (Applying)**
CO 4	Analyze CT and DT systems using Laplace transforms and Z-Transforms.	**L4(Analyzing)**
CO 5	Modeling different systems with detailed analysis of LTI systems according to different types of applications	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course Content

UNIT-I

Introduction to Signals: Signal Definition, Classification of Signals, Basic/Singularity Continuous and Discrete-Time Signals, Basic operations: Time Shifting, Time Reversal, Time Scaling on signals, Signal representation in terms of singular functions, Correlation of Signals and its Properties, Representation of a Continuous-Time Signal by its Samples: The Sampling Theorem, Reconstruction, Aliasing.

UNIT-II

Types of Systems: System, classification of Systems: Linear & Nonlinear Systems; Static & Dynamic Systems, Causal & Non-causal System, Invertible & Noninvertible, Stable & Unstable System, Time variant & Time Invariant Systems with examples.

Linear Time-Invariant Systems: Definition and Properties, Impulse Response, Convolution Sum/Integral and its Properties, Representation of LTI systems using Differential and Difference equations.

UNIT- III

Fourier Series & Fourier Transform: Introduction to Frequency domain Representation, Fourier Series Representation of Periodic Signals, Convergence of Fourier Series, Properties of Fourier Series, Fourier Transform for periodic and aperiodic signals, Convergence of Fourier Transform, Properties of Fourier Transform, Applications of Fourier Transform.

Discrete-Time Fourier Transform: Fourier Transform representation for Discrete –Time Aperiodic & Periodic Signals, Properties of Discrete-Time Fourier Transform, Basic Fourier Transform Pairs**.**

UNIT-IV

Laplace Transform: Introduction to Laplace transform, Region of convergence**(**ROC**)**, relation with Fourier transform, Properties, Inverse of Laplace transform, Application to LTI systems, their interconnections and block diagram

Z-Transform: Introduction to Z-Transform, Region of convergence (ROC), Z-Transform Properties, Inverse Z-Transform, Analysis of LTI Systems using Z-Transform, Application of Z- transform, Introduction to Hilbert Transform.

REFERENCES:

1. A. V. Oppenheim, A. S. Willsky, and S. H. Nawab "Signals & Systems", Prentice –Hall India.
2. T. K. Rawat, "Signal & Systems", Oxford University Press.
3. S. Salivahanan, A. Vallavraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw Hill.
4. A. Papoulis, "Circuits and Systems: A Modern Approach", Oxford Univ. Press.
5. B. Kumar, "Signals and Systems", New Age International Publishers.
6. H. P. Hsu, "Signals and Systems", Schaum's Outlines, TMH
7. Fred J. Taylor, "Principles of Signals and System"s, TMH
8. S. Haykins and B.V. Veen, "Signals and Systems", Wiley

Course Articulation Matrix:

Course/Course Code: Signals and Systems (PCC-EE210-T),													Semester: IV		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	2	1	-	2	2	2	2
CO2	3	3	3	2	1	-	-	-	1	-	-	2	2	2	2
CO3	3	3	3	2	2	-	-	-	1	-	-	2	3	3	2
CO4	3	3	2	1	1	-	-	-	1	1	-	2	3	2	2
CO5	3	3	2	1	1	-	-	-	1	2	-	2	3	3	2

Correlation level: **1**- slight /Low **2-** Moderate/ Medium **3-** Substantial/High

POWER ELECTRONICS LABORATORY

General Course Information:

Course Code: **PCC-EE202-P** Course Credits: 1 Mode: Practical Type: Program Core Contact Hours: 2 hours per week. Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

Course Outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Memorize the knowledge about various power converters and electric drives control methods.	**L1 (Remembering)**
CO2.	Identify relevant information to supplement to the Power Electronics devices.	**L2 (Understanding)**
CO3.	Apply a set up testing strategies and select proper instruments to evaluate performance characteristics of Power devices and power electronics circuits	**L3 (Apply)**
CO4.	Examine the basic requirements for electric drive based design.	**L4 (Analyzing)**
CO5.	apply techniques to different power electronic devices and evaluate possible causes of discrepancy in practical experimental observations in comparison to theory	**L5(Evaluating)**
CO6.	Design a model for controlling the system in an industries.	**L6 (Creating)**

LIST OF EXPERIMENTS:

1. To study the performance of single-phase half-wave and full-wave uncontrolled rectifiers.
2. To study the operation of single-phase full- wave phase control of a D.C. load using (i) a fully-controlled full-wave rectifier. (ii) A half-controlled full-wave rectifier.
3. To study speed control of a D.C. motor using single-phase half and fully controlled bridge converters.
4. To study speed control of a D.C. motor using three-phase half and fully controlled bridge converters.
5. To study and test buck, boost and buck- boost regulators.
6. To study Control speed of a single-phase induction motor using single phase AC voltage regulator.
7. To study speed control of dc motor using single-phase dual converter.
8. To study single phase diode clamp multi-level inverter.
9. To study three phase PWM inverter using IGBT.
10. To study single phase inverter with square wave quasi square wave and SPWM control.
11. To study six pulse fully controlled rectifier feeding R and RL loads.
12. To study of single phase cyclo-converter.
13. To study of three phase cyclo-converter.

NOTE: At least eight experiments are to be performed in the semester, out of which at-least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus

ELECTRICAL MACHINES-II LABORATORY

General Course Information:

Course Code: PCC-EE204-P Course Credits: 1.5 Mode: Practical Type: Program Core Contact Hours: 3 hours per week. Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

Course Outcomes

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Memorize the basics of AC rotating electric machines.	**L1(Remembering)**
CO2.	Discuss and learn about different characteristics and working design of AC rotating electric machines.	**L2(Understanding)**
CO3.	Demonstrate and interpret the working of electric machines at different operational conditions.	**L3(Apply)**
CO4.	Examine and analyze various performance characteristics of electric machines.	**H1(Analysis)**
CO5.	Select the electrical machines with ratings on the basis of their utilization and performance.	**H2 (Evaluating)**
CO6.	Design machine models for various engineering problems	**L6 (Creating)**

***Revised Bloom's Taxonomy Action verbs/Level**

List of Experiments

1. Determine mechanical losses by light running of a three phase Induction Motor.
2. To perform Load test on a 3-phase induction motor & DC generator set and to determine the efficiency of induction motor.
3. To perform light running and block rotor test to determine the parameters of the equivalent circuit of single phase induction motor.
4. To perform the open circuit test and block rotor test on three phase induction motor and draw the circle diagram.
5. To find out the rotor resistance of a poly phase induction motor.
6. To calculate regulation by synchronous impedance method:-
    a. Conduct open and short circuit test on a three phase alternator.
    b. Determine and plot variation of synchronous impedance with If.
    c. Determine S.C.R.
    d. Determine regulations for 0.8 lagging power factor, 0.8 leading power factor and unity power factor.
7. To plot V-Curves of a synchronous machine.
    a. Determination of Xo of a synchronous machine.
    b. Measurement Xd' + Xq' (Direct axis and Quardiantant axis).
8. To measure Xq of synchronous machine (negative sequence reactance).
9. To calculate regulation of synchronous machine by ZPF method.
10. To conduct the load test to determine the performance characteristics of the I.M.
11. To study the parallel operation of synchronous generators.

NOTE: At least eight experiments are to be performed in the semester, out of which at-least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

POWER SYSTEMS - I LABORATORY

General Course Information:

Course Code: **PCC-EE206-P** Course Credits: 1 Mode: Practical Type: Program Core Contact Hours: 2 hours per week. Examination Duration: 03 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

Course Outcomes:

Sr. No	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	Draw the single line diagram of the power system and power angle characteristics of transmission line.	**L2 (Understanding)**
CO2.	Calculate the parameters of transmission line from the given model and determine the voltage regulation and efficiency.	**L3 (Apply)**
CO3.	Observe and analyze the Ferranti's effect in transmission line model.	**L4 (Analyzing)**
CO4.	Modeling of 3 winding transformer and synchronous machines by determining the sequence impedances	**L6 (Creating)**

LIST OF EXPERIMENTS:

1. To draw single line diagram of distribution system of nearby area of college concerned.
2. To plot power angle characteristics of transmission line.
3. To find ABCD Parameters of a model of transmission line.
4. To find efficiency and voltage regulation of transmission line
5. To observe Ferranti effect in a model of transmission line.
6. To determine positive, negative and zero sequences of a 3 winding transformer.
7. To determine sequence impedances of a cylindrical rotor Synchronous Machine.
8. To measure the dielectric strength of transformer oil.
9. To study different types of power cables and methods of laying underground cables
10. To Study different types of Insulators
11. To find string efficiency of string insulator.
    i) Without guard ring
    ii) With guard ring.
12. To locate cable fault using cable fault locator.
13. To Study the performance of wind turbine generator system under variable load, wind speed and pitch angle.

NOTE: At least eight experiments are to be performed in the semester, out of which at-least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus