Scheme of Instruction, Evaluation and

Syllabi

of

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
FOR
WORKING PROFESSIONALS

With effect from Academic Year 2024-25

Estd. 1917 Estd. 1929

DEPARTMENT OF ELECTRICAL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Osmania University

Hyderabad – 500 007, TG, INDIA

UNIVERSITY COLLEGE OF ENGINEERING

The University College of Engineering (UCE) has the distinction of being the oldest and the biggest among the Engineering Colleges of the State of Andhra Pradesh. Established in the year 1929, eleven years after the formation of Osmania University, it was the 6th Engineering College to be established in the whole of British India. The College moved to its present permanent building in the year 1947. Today it is the biggest among the campus colleges of Osmania University. The Golden Jubilee of the College was celebrated in 1979, the Diamond Jubilee in 1989 and the Platinum Jubilee in 2004. The College was made autonomous in 1994.

The College offers four-year engineering degree courses leading to the award of Bachelor of Engineering (B.E.) in Biomedical Engineering, Civil Engineering, Computer Science and Engineering, Electrical and Electronics Engineering, Electronics and Communications Engineering and Mechanical Engineering. The College also offers courses leading to Master of Computer

Applications, Master of Science by Research and also Ph.D., in the various branches of Engineering. Part-time courses are offered both at undergraduate and postgraduate levels.

Vision

The Vision of the institute is to generate and disseminate knowledge through harmonious blending of science, engineering and technology. To serve the society by developing a modern technology in students heightened intellectual, cultural, ethical, and humane sensitivities, fostering a scientific temper, and promoting professional and technological expertise.

Mission

- To achieve excellence in Teaching and Research
- To generate, disseminate and preserve knowledge
- To enable empowerment through knowledge and information
- Advancement of knowledge in Engineering, Science and Technology
- Promote learning in free thinking and innovative environment
- Cultivate skills, attitudes to promote knowledge creation
- Rendering socially relevant technical services to the community
- To impart new skills of technology development
- To inculcate entrepreneurial talents and technology appreciation programmes
- Technology transfer and incubation

DEPARTMENT OF ELECTRICAL ENGINEERING

The Department of Electrical Engineering started in 1949 to offer B.E in Electrical Engineering. Presently, the Department is offering B.E. in Electrical & Electronics Engineering. Continuing Education for employed diploma holders was started in 1963 through the four-year Part-Time Degree course in Electrical Engineering; The Post-graduate course in Electrical Machines was started in 1966. Later, in the year 1987, B.E in Instrumentation was offered.

With a view to provide diversity and industrial orientation to the Post Graduate program, currently the Department is offering M.E. courses in Industrial Drives & Control and Power Systems, which were introduced in 1971. Department also offers part time PG courses in Industrial Drives & Control and Power Systems for the working academicians and engineers. A new PG program in Power Electronic Systems is introduced in the year 2008. The Part-Time Ph.D. program in Electrical Engineering is being offered since 1972.

The Department has eighteen regular faculty members who are highly experienced and actively involved in research activities. The Department is also equipped with state-of-art equipment and well qualified technical staff. The department is accredited by NBA for 5 years from the year 2013 and reaccredited for 3 years from the year 2019 and further in 2022 for BE(EEE) program. PG Programs in Industrial Drives & Control and Power Systems are accredited by NBA for 3 years from the year 2021.

Vision

To strive for excellence in education and research; meet the requirement of industry in the field of electrical engineering to serve the nation.

Mission

- To provide knowledge-based technology and serve to meet the needs of society in electrical and allied industries.
- To help in building national capabilities for excellent energy management and to explore non-conventional energy sources.
- To create research-oriented culture and to provide competent consultancy.
- To create and sustain environment of learning in which students acquire knowledge and learn to apply it professionally with due consideration of ethical and economic issues.
- To be accountable through self-evaluation and continuous improvement.

Programme Educational Objectives (PEO):

PEO1: To provide students with a solid foundation in Mathematics, Sciences and Electrical Engineering which prepares students for further studies and hence research in Electrical Engineering and for a wide range of career opportunities in Industries and academics.

PEO2: To train the students with good engineering breadth so as to comprehend, analyze, innovate and design new products in electrical domain, to provide technical solutions to real life problems and to render technical services to the needs of the society.

PEO3: To inculcate professional and ethical attitude, creative, effective communication and presentation skills and enhanced ability to work in teams to pursue complex, open-ended investigations and research in electrical engineering for effective knowledge transfer.

PEO4: To provide students with an academic environment aware of excellence, proactiveness, leadership positions in multidisciplinary teams, entrepreneurial talent and lifelong learning for successful professional career.

PROGRAM OUTCOMES (POs)

POs	Engineering Graduates will be able to:
PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.
PO4	**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.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
	PROGRAM SPECIFIC OUTCOMES (PSOs)
PSO1	Find solutions for effective operations and control of power systems to achieve quality and reliable power supply
PSO2	Provide solutions for effective and intelligent control of electric drives and renewable energy systems with electronic circuits for domestic and industrial applications

SCHEME OF INSTRUCTION AND EVALUATION

B.E. Working Professionals (Electrical and Electronics Engineering)

III – Semester

S. No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 301 EE	Electrical Circuits – I	3	-	-	3	3	40	60	3
2	PC 302 EE	Electrical Machines – I	3	-	-	3	3	40	60	3
3	PC 303EE	Electromagnetic Fields	3	-	-	3	3	40	60	3
4	PC 403 EE	Power Systems - I	3	-	-	3	3	40	60	3
5	PC 405 EE	Microprocessors and Microcontrollers	3	-	-	3	3	40	60	3
Practicals										
6	PC 451 EE	Electrical Circuits Lab	-	-	2	2	3	25	50	1
7	PC 453 EE	Microprocessors and Microcontrollers Lab	-	-	2	2	3	25	50	1
Total			**15**	**-**	**4**	**19**	**21**	**250**	**400**	**17**

SCHEME OF INSTRUCTION AND EVALUATION

B.E. Working Professionals (Electrical and Electronics Engineering)

IV – Semester

S. No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 401 EE	Electrical Circuits - II	3	-	-	3	3	40	60	3
2	PC 402 EE	Electrical Machines II	3	-	-	3	3	40	60	3
3	PC 404 EE	Linear Control Systems	3	-	-	3	3	40	60	3
4	PC 406 EE	Electrical Measurements and Instrumentation	3	-	-	3	3	40	60	3
5	PC 502 EE	Power Systems – II	3	-	-	3	3	40	60	3
Practicals										
6	PC 452 EE	Electrical Machines Lab – I	-	-	2	2	3	25	50	1
7	PC 552 EE	Electrical Measurements Lab	-	-	2	2	3	25	50	1
Total			**15**	**-**	**4**	**19**	**21**	**250**	**400**	**17**

SCHEME OF INSTRUCTION AND EVALUATION

B.E. Working Professionals (Electrical and Electronics Engineering)

V – Semester

S. No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 501 EE	Electrical Machines-III	3	-	-	3	3	40	60	3
2	PC 503 EE	Power Electronics	3	-	-	3	3	40	60	3
3	PC 601 EE	Utilization of Electrical Energy	3	-	-	3	3	40	60	3
4	**Professional Elective – I**		3	-	-	3	3	40	60	3
	PE 411 EE	Electrical Distribution Systems								
	PE 412 EE	Renewable Energy Sources								
	PE 413 EE	Reliability Engineering								
5	**Professional Elective – II**		3	-	-	3	3	40	60	3
	PE 521 EE	Electrical Energy Conservation and Auditing								
	PE 522 EE	IoT Applications in Electrical Engineering								
	PE 523 EE	Programmable Logic Controllers								
	PE524 EE	Electrical Machine Design								
Practicals										
6	PC 551 EE	Electrical Machines Lab – II	-	-	2	2	3	25	50	1
7	PC 553 EE	Control Systems Lab	-	-	2	2	3	25	50	1
Total			**15**	**-**	**4**	**19**	**21**	**250**	**400**	**17**

SCHEME OF INSTRUCTION AND EVALUATION
B.E. Working Professionals (Electrical and Electronics Engineering)

VI – Semester

S. No	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
1	PC 602 EE	Switchgear and Protection	3	-	-	3	3	40	60	3
2	PC 603 EE	Electric and Hybrid Vehicles	3	-	-	3	3	40	60	3
3	PC 604 EE	AI Techniques in Electrical Engineering	3	-	-	3	3	40	60	3
4	PC 605 EE	FACTS Controllers and HVDC Transmission	3	-	-	3	3	40	60	3
5	**Professional Elective – III**		3	-	-	3	3	40	60	3
	PE 631 EE	Special Electrical Machines								
	PE 632 EE	Power Quality Engineering								
Practicals										
6	PC 651 EE	Power Electronics Lab	-	-	2	2	3	25	50	1
7	PC 751 EE	Power Systems Lab	-	-	2	2	3	25	50	1
8	PW 651 EE	Mini Project	-	-	6	6	-	50	-	3
Total			**15**	**-**	**10**	**25**	**21**	**300**	**400**	**20**

SCHEME OF INSTRUCTION AND EVALUATION
B.E. Working Professionals (Electrical and Electronics Engineering)

VII – Semester

S. No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 701 EE	Power System Operation and Control	3	-	-	3	3	40	60	3
2	PC 702 EE	Electric Drives and Static Control	3	-	-	3	3	40	60	3
3	PC 304 EE	Linear Integrated Circuits	3	-	-	3	3	40	60	3
4	PC 704 EE	Power Electronic Applications in Renewable Energy	3	-	-	3	3	40	60	3
5	**Professional Elective – IV**		3	-	-	3	3	40	60	3
	PE 701 EE	Energy Management Systems								
	PE 702 EE	Smart Grid Technologies								
	PE 703 EE	Switched Mode Power Supplies								
Practicals										
6	PC 752 EE	Electrical Simulation Lab	-	-	2	2	3	25	50	1
7	PW 751 EE	Major Project Phase – I	-	-	6	6	-	50	-	3
Total			**15**	-	**8**	**23**	**18**	**275**	**350**	**19**

SCHEME OF INSTRUCTION AND EVALUATION

B.E. Working Professionals (Electrical and Electronics Engineering)

VIII– Semester

S. No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	OE – I	Open Elective – I	3	-	-	3	3	40	60	3
2	OE – II	Open Elective – II	3	-	-	3	3	40	60	3
3	MC – I	Mandatory Course – I	3	-	-	3	3	40	60	-
Practicals										
4	PW 851 EE	Major Project Phase – II	-	-	12	12	-	50	100	6
Total			**9**	-	**12**	**21**	**9**	**170**	**280**	**12**

Credit Summary

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	-	-	17	17	17	20	19	12	102

Course Code	Course Title					Course Type
PC 301 EE	ELECTRICAL CIRCUITS – I					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To acquire knowledge in electrical circuits and to understand the fundamentals of derived circuit laws.
- To acquire knowledge in steady state analysts of single-phase AC circuits.
- To understand network theorems.
- To acquire knowledge in steady state analysts of three phase AC circuits.
- To acquire knowledge in Transient analysis of circuits.

Course Outcomes:

1. Apply source transformation, star-delta transformation, and mesh & node analysis to analyze networks.
2. Evaluate steady state behavior of single-phase AC networks and design the series and parallel RLC circuits for the required bandwidth, resonant frequency and quality factor.
3. Analyze electric circuits using network theorems for AC and DC networks.
4. Evaluate steady state behavior of three-phase AC networks and analyze the coupled circuits.
5. Evaluate transient and steady response of networks for various excitations by solving differential equations.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	3	2	1	2	-	-	-	2	2	-	2	2	2
CO2	3	3	3	2	2	-	-	-	2	2	-	2	2	2
CO3	3	3	3	2	2	-	-	-	2	2	-	2	2	2
CO4	3	3	3	2	2	-	-	-	2	2	-	2	2	2
CO5	3	3	3	2	2	-	-	-	2	2	-	2	2	2

UNIT- I

Network Elements & Laws*:* Active elements, Independent and dependent sources. Passive elements — R, L and C, Energy stored in inductance and capacitance, Kirchhoff's laws, Source transformations, Star-delta transformations, Node voltage method, Mesh current method including super node and super mesh analysis.

UNIT- II

Single-Phase Circuits*:* RMS and average values of periodic sinusoidal and non-sinusoidal waveforms, Phasor representation, Steady-state response of series, parallel and series-parallelcircuits. Impedance, Admittance, Current locus diagrams of RL and RC series and parallelcircuits with variation of various parameters. Resonance: Series and parallel circuits, Band-widthand Q-factor.

UNIT- III

Network theorems*:* Superposition theorem, Thevenin's theorem, Norton's theorems, Maximum power transfer theorem, Tellegen's theorem, Compensation theorem, Milliman's theorem and Reciprocity theorem. (AC & DC)

UNIT- IV

Poly-phase Circuits: Analysis of balanced and unbalanced 3-phase circuits, Star and delta connections, Measurement of three-phase power for balanced and unbalanced loads.

Coupled circuits: Concept of self and mutual inductance, Dot convention, Coefficient of coupling, Analysis of circuits with mutual inductance.

UNIT- V

Transient analysis: Transient response of RLC circuits, Formulation of integral differential equations, Initial conditions, Response of RL, RC and RLC networks subjected to internal energy, Response to impulse, step, ramp, exponential and sinusoidal excitations.

Suggested Reading:

1. Van Valkenburg M.E., *Network Analysis,* Pearson education, 3rd Edition, 2019.
2. William Hayt H, Kimmerly Jack E, Steven Durbin M, *Engineering Circuit Analysis*,McGraw-Hill, 7th Edition, 2006.
3. Jagan N.C, Lakshrninarayana C., *Network Analysis,* B.S. Publications, 3rd Edition, 2019.
4. Chakravarthy A., *Circuit Theory Analysis and Synthesis*, Dhanpat Rai & Co., Seventh Edition, 2018

Course Code	Course Title					Course Type
PC 302 EE	ELECTRICAL MACHINES – I					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To learn and understand the principle of electromechanical energy conversion.
- To be able to understand in detail about D.C Machines, construction, principle, performance characteristics and testing.
- To be able to understand the D.C Generators, their types, characteristics and applications.
- To be able to understand in detail about D.C Motors, performance curves, speed control methods, and various types of starters for DC motors and applications.
- To obtain the power loss and calculate the efficiency of DC machines.

Course Outcomes:

1. Understand electromechanical energy conversion principle with singly and doubly exited magnetic systems
2. Understand construction, operating principle of DC Machines.
3. To be able to analyze the types, characteristics and applications of DC Generators and Motors
4. To be able to calculate performance parameters of DC Motors and their applications.
5. To be able to analyze the power losses, calculate the efficiency and testing of D.C Machines.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	2	3	2	1	1	1	-	-	-	-	-	1	-	-
CO2	3	2	-	3	2	3	1	-	-	-	2	1	-	2
CO3	2	1	-	1	1	1	-	-	-	-	1	-	-	2
CO4	2	1	-	1	1	2	-	-	-	-	1	-	-	3
CO5	2	1	1	1	1	2	1	-	-	-	1	-	-	2

UNIT– I

Electromechanical energy conversion: Principle of energy conversion, Flow of energy in electromechanical devices, Coupling-field reaction, singly excited magnetic system – Electric energy input, Magnetic field energy stored, Mechanical work done with slow, instantaneous and transient movement of armature, Calculation of mechanical force, doubly excited magnetic systems, electromagnetic and reluctance torques.

UNIT- II

DC Machines: Simple loop generator, Essential parts of DC machine, Details of Lap winding& Wave winding, EMF equation, Armature reaction— Remedies, Ampere turns, Commutation — reactance voltage, Methods of improving commutation — High resistance brushes, shifting of brushes, inter poles, Compensating winding.

UNIT- III

DC Generators: Classification & types of DC generators, Open circuit, Internal & External characteristics—Critical resistance & critical speed, Voltage regulation, Conditions for self- excitation, Causes of failure of voltage buildup, Parallel operation Series, Shunt and Compound generators, Applications.

UNIT- IV

DC Motors: Classification &Types of DC motors, Back emf, Speed regulation, Armature torque, Armature reaction, Operating characteristics, Performance curves, Basic speed control methods Shunt and Series motors, Three & four-point starters, Calculation of step resistances, Applications

UNIT- V

Testing, Losses and Efficiency: Power losses—Copper losses and Rotational losses, Power flow, Efficiency, Testing - Brake Test and Swinburne's test, Hopkinson's test, Field's test, Retardation test, Heat run test.

Suggested Reading:

1. D.P. Kothari, I.J. Nagrath, Electric Machines, Tata McGrawHill,4thEdition,2017
2. Bhimbra. P.S., Electrical Machinery, Khanna Publications,2021
3. Gupta J.B., Theory and Performance of Electrical Machines, S.K. Kataria&Sons, Delhi 2005.
4. AE Clayton and NN Hancock, The Performance and Design of Direct CurrentMachines,3rd edition,1959.

Course Code	Course Title					Course Type
PC 303 EE	ELECTROMAGNETIC FIELDS					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To be able to understand the concepts of electrostatic fields, magneto static fields.
- To understand the concepts of electromagnetic wave propagation in different

Course Outcomes:

1. Understand the basic concept of electrostatic field and formulate problems with
2. Derive expression for the energy stored in electrostatic field, electrostatic
3. Understand the basic concept of magnetic field and formulate problems with the
4. Derive expression for Maxwell's equations, energy stored in electric andmagnetic field
5. Application of EM wave propagation and calculate the reflection and refraction coefficient of electromagnetic field.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	2	3	1	1	3	2	-	2	1	2	1	3	2
CO2	3	2	3	1	1	3	2	-	2	1	2	1	3	2
CO3	3	2	3	1	1	3	2	-	2	1	2	1	3	3
CO4	3	2	3	1	1	3	2	-	2	1	2	1	3	3
CO5	3	3	3	1	1	3	2	-	2	1	2	1	3	3

UNIT– I

Review of Vector Analysis: Coulomb's Law, Electric field intensity, Electric field due to different charge distributions. Electric field due to line charge, Sheet charge, Volume charge distribution, Electric flux density, Gauss's law, Divergence theorem. Potential, Potential gradient, Potential field of different charge distributions, Applications of above laws.

UNIT- II

Energy in electrostatic field, Poisson's and Laplace equations, Uniqueness theorem, Solution of Laplace's equation, Conductors, Conductor properties, Dielectric, Dielectric properties and Boundary conditions, Calculation of capacitance, Boundary conditions for conductors and perfect dielectric materials.

UNIT- III

Steady magnetic field, Biot-Savart's law, Ampere's law, Stoke's theorem, Magnetic scalar and vector potential, Faraday's law, Self and Mutual inductances, Force on moving charge, Force on differential elements, Magnetic boundary conditions, Magnetic circuits, Analogy with electrical circuits, Applications of above laws.

UNIT- IV

Maxwell's equations in Integral form, differential forms, Line and surface integrals, Boundary conditions, Continuity equation, Field equations in vector forms, energy storage in electric and magnetic fields.

UNIT- V

EM waves in homogeneous medium solutions for free space conditions, Uniform plane wave propagation, Poisson's, and Laplace's equations, Sinusoidally time varying uniform plane waves in free space, Uniform plane waves in dielectrics and conductors, Poynting vector, Power dissipation, Reflection of uniform plane waves, Introduction to method of moments,

Suggested Reading:

1. Matthew Sadiku N.O., Elements of Electromagnetics, Oxford University Press, 7th Edition 2018.
2. William. Hayt H, Buck John A., Engineering Electromagnetics, Tata McGraw Hill, 7th Edition, 2003.
3. Nannapaneni Narayana Rao, Elements of Engineering Electromagnetics, PHI, NewDelhi, 5th Edition, 2002.
4. Matthew Sadiku N.O., Elements of Electromagnetics, Oxford University Press, 4th Edition, 2006.

Course Code	Course Title					Course Type
PC 403 EE	POWER SYSTEMS – I					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To introduce the economic aspects of power generation and tariff methods and understand the concepts of A.C. and D.C. distribution.
- To understand the working of conventional power plants like Thermal, Hydel
- and Nuclear.
- To understand the basic working principles of renewable power plants like
- Solar, Wind and Gas Turbine power plants.
- To understand about various overhead line components and cables.
- To familiarize with transmission line parameter calculations.

Course Outcomes:

1. Evaluate various economic aspects of power generation like depreciation fund calculations and Tariffs and perform A.C. and D.C. distribution calculations.
2. Understand the operation of conventional power plants.
3. Understand the basic working principle of renewable power plants like Solar, Wind, and Gas turbine plants.
4. Evaluate the performance of overhead line insulators and underground cables and to perform sag calculations.
5. Determine the electrical circuit parameters of transmission line.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	-	-	-	2	-	-	-	-	2	3	-
CO3	3	2	1	-	-	-	2	-	-	-	-	3	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-

UNIT– I

Economics of Power Generation: Load Curve, Load Demand and Diversified factors, Base Load and Peak load operation, Types of costs and depreciation fund calculations, Methods of power factor improvement, Economics of power factor improvement, Tariffs, Distribution: 2 wire and 3 wire distributors, Ring mains,

AC distribution calculations.

UNIT- II

Steam Power Stations: Choice of site, Layout & various parts of station, Boilers, Turbines,Super Heaters, Economizers, Air pre-heaters etc. and their Pulverized fuel, Coal handling.

Hydro-Electric Power plants: Estimation Hydrograph, Flow duration curve, Mass curve,Storage and pondage, Types electric plants and layouts, Prime movers for hydroelectric plants.

UNIT- III

Nuclear Power Plants: Fissile materials, working principle of nuclear plants and reactorcontrol, Shielding, Types of reactors.

Non-Conventional Energy Sources: Basic principles of Wind, solar and gas turbines.

UNIT- IV

Over-Head Lines: Supports sag and tension calculations, Effect of wind and ice, Erection conditions, Insulators: Types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, Testing of insulators.

Insulated Cables: Conductors for cables, Insulating materials, Mechanical protection, Lowvoltage cables, Grading of cables, Three phase high voltage cables and Super voltage cables,Capacitance of three-core cables.

UNIT- V

Inductance and Capacitance of Transmission Lines: Inductance and capacitance of overhead line conductors, Single phase and three phase with symmetrical compositeconductors, GMR and GMD Spacing, Transposition, Bundled conductors, Effect of earth capacitance.

Suggested Reading:

1. Wadhwa C.L., *Electrical Power Systems*, New Age International (P) Ltd., 8th Edition, 2022.
2. Wadhwa C.L., *Generation, Distribution and Utilization of Electrical Energy*, New Age International (P) Ltd., 4th Edition, 2017.
3. Singh S.N., *Electrical Power Generation*, Transmission and Distribution, Prentice Hall of India, Pvt. Ltd., New Delhi, 2nd Edition, 2008.
4. V.K. Mehta, *Principles of Power Systems*, S. Chand and Co., 7th Edition, 2021.

Course Code	Course Title					Course Type
PS 405 EE	MICROPROCESSORS AND MICROCONTROLLERS					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To understand about 8086 microprocessor architecture and its different features.
- To know Instruction set and addressing modes of 8086 and writing assembly
- To know the use of interfacing devices and process of interfacing.
- To understand about 8051 microcontroller architecture and its different features.
- To know Instruction set and addressing modes of 8086 and writing assembly

Course Outcomes:

1. Acquire the knowledge of Architecture of 8086, interrupts, timing diagrams.
2. Write assembly language programs of 8086 for a given task.
3. Interface memory and I/O devices to 8086 using peripheral devices.
4. Acquire the knowledge of 8051 Micro controller and its resources.
5. Write assembly language programs of 8051 for a given task.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	1	1	1	-	1	-	-	-	-	-	3	-	2
CO2	3	3	3	2	3	2	-	-	-	-	-	3	-	2
CO3	3	3	3	3	-	2	-	-	-	-	-	3	-	2
CO4	3	1	1	1	-	1	-	-	-	-	-	3	-	3
CO5	3	3	3	3	3	2	-	-	-	-	-	3	-	3

UNIT– I

Microprocessor: Evolution of Microprocessors, Internal architecture of 8086 - Segmented memory, Registers, Pin diagram of 8086 in minimum and maximum mode configuration - Timing diagram of typical read write instructions - Interrupts, Steps in interrupt process, Interrupt structure in 8086, Internal and external interrupts-interruptservice routines.

UNIT- II

Introduction to Programming: Instruction set and addressing modes of 8086 Assemblylanguage programming, Assembler directives, Simple programs using assembler.

UNIT- III

Interfacing the Microprocessor: Memory and I/O interfacing, 8255(PPI), Programmable Internal Timer (8253), Programmable Interrupt Controller (8259), MatrixKey board, seven segment display, A/D and D/A interfacing.

Serial interface and data converters: USART 8251, Serial interface standards-RS 232 Cand RS -485.

UNIT- IV

Micro Controller Architecture: Types of Micro Controllers, 8051 Micro Controller - Internal architecture, Pin diagram, Memory organization, Parallel I/O Ports, Timer/Counters, Serial data interface and, Interrupts & timers.

UNIT- V

Introduction to Programming: Instruction set and addressing modes of 8051, Classification of instructions, Simple assembly language programs, Interfacing using8051.

Suggested Reading:

1. Douglas. V. Hall, Microprocessors, and Interfacing -Tata McGraw Hill -Revised 2nd Edition, 2005.
2. Krishna Kant -Microprocessors and Microcontrollers - Architecture, Programmingand System Design 8085, 8086, 8051, 8096, Prentice-Hall India - 2007.
3. Kenneth. J. Ayala – "The 8051 Microcontroller Architecture Programming and Applications", Thomson publishers, 2nd Edition, 2007.
4. Waiter A. Triebel& Avtar Singh - The 8088 and 8086 Microprocessor -Pearson Publishers, 4th Edition, 2007.
5. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Prentice HallPublications, 2nd Edition, 2008.

Course Code	Course Title					Course Type
PC 451 EE	ELECTRICAL CIRCUITS LAB					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	-	-	2	3	25	50	1

Course Objectives:

- To Train the Students for acquiring practical knowledge in time response and frequency response of series / parallel RC, RL and RLC Circuits.
- To prepare the students for finding out parameters of a given two port networks.
- To make the students for understanding the verification of theorems.
- To Train the Students for acquiring practical knowledge single phase AC circuits.
- To Train the Students for acquiring practical knowledge three phase AC circuits.

Course Outcomes:

1. Evaluate the time response characteristics of R, L, C Circuits.
2. Evaluate the frequency response characteristics of R, L, C Series and parallel circuits.
3. Validate the network theorems.
4. Find various parameters of a two-port network.
5. Obtain power using two-wattmeter method

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	1	1	1	-	1	-	-	2	3	-	3	-	2
CO2	3	3	3	2	3	2	-	-	2	3	-	3	-	2
CO3	3	3	3	3	-	2	-	-	2	3	-	3	-	2
CO4	3	1	1	1	-	1	-	-	2	3	-	3	-	3
CO5	3	3	3	3	3	2	-	-	2	3	-	3	-	3

LIST OF EXPERIMENTS:

1. Charging and Discharging Characteristics of RC series circuits.
2. Locus diagrams of RC and RL Circuits.
3. Study of single phase RLC circuits.
4. Frequencies Response of a Series RLC Circuits.
5. Frequencies Response of a Parallel RLC Circuits.
6. Parameters of two port network.
7. Series, parallel and cascade connection of two port networks.
8. Verification of Theorems.

(a) Thevenin's theorem

(b) Norton's theorem

(c) Superposition

9. Verification of Theorems.

Course Code	Course Title					Course Type
PS 453 EE	MICROPROCESSORS AND MICROCONTROLLERS LAB					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	-	-	2	3	25	50	1

Course Objectives:

- To provide solid foundation in assembly language programming of 8086 Microprocessor and 8051 Micro controllers.
- To provide the knowledge of interfacing the external devices to the Microprocessor and Micro controller according to the user requirements to create novel products and solutions for the real time problems.

Course Outcomes:

1. Familiarize with the instruction set of 8086.
2. Write programs for given task using different addressing modes.
3. Interface various I/O devices using 8255 PPI and 8051.
4. Understand the instruction set of 8051 and its application.
5. Write the assembly language programs of microcontroller for a given

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	1	3	1	-	1	-	-	2	3	-	3	-	2
CO2	3	3	3	2	3	2	-	-	2	3	-	3	-	2
CO3	3	3	3	3	-	2	-	-	2	3	-	3	-	2
CO4	3	1	1	1	-	1	-	-	2	3	-	3	-	3
CO5	3	3	3	3	3	2	-	-	2	3	-	3	-	3

LIST OF PROGRAMS:

8085 assembly language programs:

1. Programs to transfer data from one memory location to another location.
2. Signed/unsigned addition, subtraction, multiplication, and division.
3. Finding average, largest, square root, etc.,
4. Sorting set of numbers.
5. Code conversion like BCD numbers into binary.

6. 8255 PPI for interfacing LEDs.
7. 8255 PPI for interfacing to generate triangular wave using DAC.

8051 assembly language programs:

1. Data transfer – block move, exchange, sorting, finding largest element in array.
2. Arithmetic instructions: addition, subtraction, multiplication, and division.
3. Boolean & logical instructions (Bit manipulations).
4. Programs to generate delay, programs using serial port and on chip timer/counter.
5. Use of JUMP and CALL instructions.
6. Square wave generation using timers.
7. Interfacing of keyboard and 7-segment display module.
8. DAC interfacing for generation of sinusoidal wave.

Course Code	Course Title					Course Type
PC 401 EE	ELECTRICAL CIRCUITS – II					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To acquire knowledge in Applications of Fourier series Fourier transform & Laplace transform to networks.
- To acquire knowledge in two-port network parameters
- To understand the application of Graph theory.
- To understand properties of network functions.
- To understand the methods of electric network synthesis.

Course Outcomes:

1. Evaluate the behavior of networks using Fourier series, Fourier transform & Laplace transforms.
2. Obtain two port network parameters and applications of graph theory to electric circuits.
3. Apply graph theory to electric circuits.
4. Test the given function for Positive real function.
5. Synthesize a network in terms of RL, RC and RLC parameters.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	3	2	2	2	-	-	-	2	2	-	2	2	2
CO2	3	3	3	2	2	-	-	-	2	2	-	2	2	2
CO3	3	3	3	2	2	-	-	-	3	2	-	2	2	2
CO4	3	3	3	2	2	-	-	-	3	2	-	2	2	2
CO5	3	3	3	2	2	-	-	-	3	2	-	2	1	2

UNIT- I

Fourier Series and Integral: Review of Fourier series and Fourier Transforms, Application ofFourier series and Fourier transforms to simple networks.

Laplace Transform Method of Analysis of Networks: Laplace properties and theorems, Waveforms synthesis, Partial fraction method of inverse transforms, Application to networks,Transfer functions.

UNIT- II

Two port network parameters: Open circuit impedance parameters, Short circuit admittance parameters, Transmission parameters, Hybrid parameters, conditions for Reciprocity and Symmetry, Inter-relationships between different sets of parameters, Interconnection of two portnetworks: Series, parallel and cascade connection.

UNIT- III

Topological Description of Networks: Graph, tree, chord, cut-set, incident matrix, circuit matrixand cut-set matrix, Formulation of network equations, Node voltage equations, loop current equations, cut-set equations for RLC networks.

UNIT- IV

Network synthesis: Driving point impedance and admittance functions, Concept of Poles and zeros in a network function, Positive real function, Properties of Positive real functions, Testingof Positive real functions, Hurwitz polynomial.

UNIT- V

Network synthesis: Basic operations in synthesis, Properties of LC, RC and RL networks, Properties of networks in terms of poles and zeros, Synthesis of LC, RC, RL functions, Fosterforms, Cauer forms, Properties of RLC networks, Synthesis of RLC networks.

Suggested Reading:

1. Van Valkenburg M.E., *Network Analysis*, Pearson education, 3rd Edition, 2019.
2. William Hayt H, Kimmerly Jack E, Steven Durbin M, *Engineering Circuit Analysis*,McGraw-Hill, 7th Edition, 2006.
3. Jagan N.C, Lakshrninarayana C., *Network Analysis*, B.S. Publications, 3rd Edition, 2019.
4. Chakravarthy A., *Circuit Theory Analysis and Synthesis*, Dhanpat Rai & Co., Seventh Edition, 2018.
5. Samrajith Ghosh, *Network theory Analysis and Synthesis*, PHI Learning private limited, firstedition , 2005.

Course Code	Course Title					Course Type
PC 402 EE	ELECTRICAL MACHINES – II					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To be able to understand in detail about transformers and induction machines. Construction, principle, performance characteristics and testing.
- To understand the construction, principle and performance characteristics of fractional HP Motors
- To understand the type of connections of 3-phase transformers, constructional features
- of transformers and parallel operation of transformers.
- To be able to understand the starting methods and speed control methods of 3-
- To understand the principle of operation of Induction Generator.

Course Outcomes:

1. Acquire the knowledge of construction, principle of operation and testing of single- phase transformers.
2. Impart the knowledge about three phase transformers, three phase to two phase.
3. Acquire the knowledge about the constructional details, equivalent circuit parameters
4. Acquire the knowledge about starting and speed control methods of three phase
5. Impart the knowledge of constructional details, principle of operation and types of

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	2	-	1	-	1	1	-	-	-	-	1	-	1	1
CO2	2	1	1	1	1	1	-	-	-	-	1	1	1	1
CO3	2	1	1	1	1	1	-	-	-	-	1	-	1	1
CO4	2	1	1	1	1	1	-	-	-	-	1	-	1	1
CO5	2	1	1	1	1	1	-	-	-	-	1	-	1	-

UNIT– I

Single Phase Transformers: Constructional features of single phase transformers, principleof two winding transformer, ideal transformer - transformer on no load and on load – phasor diagrams- equivalent circuits, losses, Testing - Polarity test, OC and SC tests, Sumpner's test, Regulation and efficiency, All day efficiency, separation of losses - Excitation phenomena intransformers, Auto transformer - Comparison with two winding transformer and applications.

UNIT- II

Three - Phase Transformers: Connections - Choice of transformer connections – Third harmonic voltages - Phase conversion - 3-phase to 2-phase transformation, Scott connection –constructional features of poly phase transformers - Tertiary winding, Parallel operation of transformers, phase shifting transformer, Tap changer.

UNIT- III

Three - Phase Induction Motor: Constructional features - Rotating magnetic field theory, Principle of operation of Squirrel cage and Slip ring motors, Phasor diagram, Equivalent Circuit – expression for torque - starting torque - Max torque. Slip-torque characteristics, Equivalent circuit parameters from no-load and blocked rotor test, Circle diagram, Determination of performance characteristics of induction motor, Applications.

UNIT- IV

Starting & Speed Control Methods: Starting methods of 3-phase induction motor –Autotransformer, Star-delta Starter. Double cage machine, Speed control methods – Resistancecontrol, Voltage Control, Pole changing, Cascading, Induction Generator - Principle of operation, Applications.

UNIT- V

Single Phase Motors: Double field revolving theory. Equivalent circuit of single-phase inductionMotor-Principle of operation, speed torque characteristics of a split phase and capacitor motors.Compensated and uncompensated series motor, Repulsion motor and universal motor Applications

Suggested Reading:

1. P.S. Bimbhra- Electrical Machinery, Khanna Publishers 2006.
2. D.P. Kothari & I.J. Nagrath, Electrical Machines, Tata McGraw Hill, 4th Edition, 2010.
3. M.G.Say - The Performance and Design of AC. Machines Pitman Publication, 2002.
4. Irving L. Kosow - Electric Machinery and Transformers. PPH, Pearson Education, 2nd
5. Edition,2009

Course Code	Course Title					Course Type
PC 404 EE	LINEAR CONTROL SYSTEMS					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To develop basic skills of utilizing mathematical tools needed to analyze and design classical linear control systems.
- To understand and develop the state space representation of control systems.

Course Outcomes:

1. Develop Mathematical modeling of Electrical and Mechanical systems.
2. Determine Transient and Steady State behavior of systems using standard test
3. Analyze the system in time domain using Routh's stability criterion and root locus.
4. Analyze the system in frequency domain using Nyquist stability criterion and Bode plot. Design controllers to meet desired specifications.
5. Develop state space models for control systems.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO2	3	3	2	2	-	2	-	-	-	-	-	2	2	2
CO3	3	3	3	3	-	2	-	-	-	-	-	2	2	2
CO4	3	3	3	3	-	2	-	-	-	-	-	2	2	2
CO5	3	3	2	3	-	2	-	-	-	-	-	2	2	2

UNIT– I

Introduction to Control Systems: Classification of control systems. Feed-Back Characteristics, Effects of feedback - Mathematical modeling of Electrical and Mechanical systems -Transfer function- Transfer function of Potentiometer, synchro, AC servo motor, DC servo motor - Block diagram reduction technique - Signal flow graph, Mason's gain formula

UNIT- II

Time Domain Analysis: Standard test signals - Time response of first order systems - Transient response of second order system for unit step input, Time domain specifications - Steady state response - Steady state errors and error constants - Effects of P, PD, Pl and PID controllers on system performance.

UNIT- III

Stability Analysis in S-Domain: The concept of stability - Routh's stability Criterion, Absolute stability and relative stability- limitations of Routh's stability**.**

Root Locus Technique: The root locus concept - construction of root loci- Eff ects of adding poles and zeros on the root loci.

UNIT- IV

Frequency Response Analysis: Introduction to frequency response - Frequency domain specifications - Bode plot - Stability analysis from Bode plots - Determination of transfer function from the Bode Diagram - Polar Plots, Nyquist Plots, Stability Analysis, Gain margin and phase margin.

Control System Design: Introduction - Lag, Lead and Lag-Lead Compensator design in frequency Domain

UNIT- V

State Space Analysis: Concepts of state, State variables and state model, Derivation of state models of linear time invariant systems - Controllable, Observable and Diagonal state models - State transition matrix - Solution of state equation - Concepts of Controllability and Observability.

Suggested Reading:

1. Nagrath I.J. & Gopal.M - Control System Engineering, Wiley Eastern, 2003.
2. B.C.Kuo - Automatic Control Systems, Wiley India edition, 7th Edition, 2002.
3. K.Ogata - Modern Control System, Prentice Hall of India, 4th edition, 2002.
4. N.C.Jagan - Control Systems, B.S Publications, 2nd edition,2008.
5. S.Palani, Anoop K Jairath - Automatic Control System, Ane books Pvt. Ltd, 2013
6. Anand Kumar, Control Systems, PHI Learning Private Limited, 2011

Course Code	Course Title						Course Type
PC 406 EE	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To learn and understand the fundamental concepts, principle of operation and applications.
- To understand various types of Bridges in measurement of resistance, inductance, capacitance.
- To understand the operation and applications of Ballistic Galvanometer, Flux meter and DC/AC Potentiometer.
- To understand the application of CRO for measurement of Amplitude and Phase

Course Outcomes:

1. Choose the suitable instrument like Ammeter, Voltmeter for AC/DC applications.
2. Select suitable Bridge for measurement of electrical parameters and quantities.
3. Use of CRO for the measurements.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	1	1	1	-	1	-	-	-	-	-	3	-	2
CO2	3	3	3	2	3	2	-	-	-	-	-	3	-	2
CO3	3	3	3	3	-	2	-	-	-	-	-	3	-	2
CO4	3	1	1	1	-	1	-	-	-	-	-	3	-	3
CO5	3	3	3	3	3	2	-	-	-	-	-	3	-	3

UNIT– I

Instruments: indicating, Recording and Integrating instruments, Ammeter, Voltmeter, Expression for torque of moving coil, moving iron, Dynamometer, induction and electrostatic instruments. Extension of range of instruments, Wattmeter Torque expression for dynamometer instruments, Reactive power measurement.

UNIT- II

Meters: Energy meters, single phase and 3-phase, Driving torque and braking torque equations, Errors and testing compensation, Maximum demand indicator, Power factor meters, Frequency meters, Electrical resonance and Weston type of synchroscope.

UNIT- III

Bridge Methods and transducers: Measurement of inductance, capacitance and resistance using Bridges, Maxwell's, Hay's. bridge, Anderson, Wein, Desauty's, Schering's bridges, Kelvin's double bridge, Megger, Loss of charge method, Wagner's earthing device, Transducers - Analog and digital transducers, Strain gauges and Hall eff ect transducers.

UNIT- IV

Magnetic Measurements and instrument transformers: Ballistic galvanometer, Calibration by Hibbert' s magnetic standard flux meter, Lloyd-Fischer square for measuring iron loss, Determination of B-H curve and Hysteresis loop using CRO, Instrument transformers – Current and potential transformers, ratio and phase angle errors of CT's and PT's.

UNIT- V

Potentiometers: Crompton's DC and AC polar and coordinate types, Applications, Measurements of impedance, Calibration and ammeter voltmeter and wattmeter. Use of oscilloscope in frequency, phase and amplitude measurements

Suggested Reading:

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpatrai & Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement & Instrumentations, Satya Prakashan, New Delhi.
3. Golding E.W., Electrical Measurements & Measuring Instruments, Sir Issac& Pitman & Sons Ltd., London.
4. U.A.Bakshi, A.V.Bakshi, Electrical and Electronic Instrumentation, Technical publications

Course Code	Course Title					Course Type
PC 502 EE	POWER SYSTEMS –II					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- To learn and understand the performance analysis of short, medium and long transmission lines.
- To comprehend analysis of symmetrical and unsymmetrical faults in the power system.
- To learn the use of per unit quantities and calculation of symmetrical faults on OH transmission lines.
- To give awareness about importance for maintaining constant voltage and different voltage control methods.
- To learn about the natural impedance of transmission line and significance in the operation of power system network.

Course Outcomes:

1. Acquire modeling of different short, medium and long transmission lines.
2. Learn the use of per unit quantities and calculation of symmetrical faults on OH transmission lines Deal with applications like timer/counter, registers etc.
3. Understand the impact of different types of faults on overhead transmission lines and calculation of fault currents and their significance.
4. Explain the reasons for voltage variation, importance of maintaining constant voltage in power system and different voltage control methods.
5. Acquire the knowledge of natural impedance of transmission line and significance in the operation of power system network.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	3	1	-	-	-	-	-	1	-	-	1	2	-
CO2	3	3	1	-	-	-	-	-	1	-	-	1	2	-
CO3	3	3	1	-	-	-	-	-	1	-	-	1	2	-
CO4	3	3	1	-	-	-	-	-	1	-	-	1	2	-
CO5	3	3	1	-	-	-	-	-	1	-	-	1	2	-

UNIT– I

Transmission Line Theory: Modelling and Performance of short, medium, long lines – Surge Impedance Loading-Tuned lines, Power circle diagram and their applications.
Corona - Causes - Disruptive and Visual critical voltages - Power loss - Minimization of corona effects.

UNIT- II

Symmetrical Faults: Use of per unit quantities in power systems, advantages of per unit system. Symmetrical Three-phase Faults, Transients in RL series circuits - Short circuit currents - Reactances of synchronous machines – Reactance diagram-Symmetrical fault calculations, Short circuit capacity of bus.

UNIT- III

Unsymmetrical Faults: Symmetrical components of unsymmetrical phasors - Power in terms of symmetrical components - Sequence impedance and sequence networks, Sequence networks of unloaded generators - Sequence impedances of circuit elements - Single line to ground, line to line and double line to ground faults on unloaded generator - Unsymmetrical faults of power systems, Open circuit faults.

UNIT- IV

Voltage Control: Phase modifiers, Induction Regulators -Tap changing Transformers, Series and Shunt Capacitors, Reactive Power requirement calculations, Static VAR compensators - Thyristor Controlled reactor, Thyristor switched capacitor.

UNIT- V

Travelling Wave Theory: Causes of over voltages - Travelling wave theory - Wave equation - Open circuited line - The short circuited line - Junction of lines of different natural impedances - Reflection and Refraction Coefficients - Junction of cable and overhead lines - Junction of three lines of different natural impedances- Bewley Lattice diagram.

Suggested Reading:

1. CL Wadhwa - Electrical Power Systems, New Age International, 4th edition, 2006.
2. Grainger and Stevenson - Power System Analysis, Tata McGraw Hill, 4th edition, 2003.
3. Nagarath and Kothari - Modern Power System Analysis, Tata McGraw Hill, 4th edition- 2012.

Course Code	Course Title					Course Type
PS 452 EE	ELECTRICAL MACHINES LAB - 1					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	-	-	2	3	25	50	1

Course Objectives:

- To learn operation and performance characteristics of d.c machines by conducting various experiments and tests practically.
- To understand the operation and performance characteristics of transformers by conducting various experiments and tests.
- To estimate the efficiency of DC Machine by separation of losses using suitable tests practically.
- To calculate the efficiency of Transformer by conducting No Load and Short-circuit test's Practically.
- To Analyze the connections of three-phase transformer.

Course Outcomes:

1. Estimate the efficiency and voltage regulation of D.C. generator and transformers.
2. Acquire the knowledge sufficiency and speed regulation D.C. Motors under various loading conditions.
3. Able to understand the speed control of DC motor by conducting diff erent experiments
4. To be able to calculate the various parameters of machine and transformers by
5. conducting suitable testing.
6. To be able to calculate the various parameters of three-phase transformers by using
7. three phase transformer connections.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1	3	-	-	3	-	-	-	-	2	-	-	-	-	-
CO2	3	-	-	3	-	-	-	-	2	-	-	-	-	-
CO3	2	-	-	3	-	-	-	-	2	-	-	-	-	-
CO4	2	2	-	3	-	-	-	-	2	-	-	-	-	-
CO5	2	2	-	3	-	-	-	-	2	-	-	-	-	-

LIST OF EXPERIMENTS:

1. Magnetization characteristics of a separately excited D.C.generator.
2. Determination of the load characteristics of shunt andcompound generators.
3. Determination of the performance and mechanical characteristics of series, shunt, and compound motors.
4. Separation of iron and friction losses and estimation ofparameters in D.C. machine.
5. Speed control of D.C. Shunt motor using shuntfield control and armature control methods.
6. Separation of core losses in a single-phase transformer.
7. Open circuit and short circuit and load test on a single-phase transformer.
8. Sumpner's test on two identical transformers.
9. Three phase Transformer connections.
10. Three phase to two phase transformation and open deltaconnection.
11. Retardation test.
12. Hopkinson's test.
13. Swinburne's test.

Course Code	Course Title					Course Type
PC 552 EE	ELECTRICAL MEASUREMENTS LAB					Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation	Credits
	L	T	P		CIE	SEE	
	-	-	2	3	25	50	1

Course Objectives:

- To acquire practical knowledge for measuring resistance, inductance and capacitance using various bridges.
- To understand the usage of A.C. and D.C. potentiometers.
- To acquire knowledge about the operation of CRO and its usefulness in finding the amplitude, phase and frequency of waveforms.
- To acquire knowledge about the functionality of single phase energy meter.
- To acquire knowledge about the measurement of iron losses using Lloyd Fishers magnetic square.

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Course Outcomes:

1. Measure the inductance, capacitance and resistance using various bridges.
2. Measure resistance and calibrate ammeter, voltmeters and wattmeter using A.C. and D.C. potentiometers.
3. Have hands on experience on the operation of CRO.
4. Calibrate single phase energy meter using direct loading.
5. Measure iron losses using Lloyd Fishers magnetic square.

Articulation matrix of Course Outcomes with POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	2	-	1	2	-
CO2	3	-	-	-	-	-	-	-	2	2	-	1	2	-
CO3	3	-	-	-	-	-	-	-	2	2	-	1	2	-
CO4	3	-	-	-	-	-	-	-	2	2	-	1	2	-
CO5	3	-	-	-	-	-	-	-	2	2	-	1	2	-

LIST OF EXPERIMENTS:

1. Measurement of low resistance by Kelvin's Double Bridge.
2. Calibration of single phase energy meter.
3. Measurement of inductance by Maxwell's and Anderson's bridges.
4. Measurement of capacitance by Desauty's and Schering's bridges.
5. Measurement of Iron losses by Lloyd Fishers magnetic square.
6. Measurement of Resistance and calibration of Ammeter using D.C. potentiometer.
7. Calibration of voltmeter and wattmeter using D.C. potentiometer.
8. Measurement of unknown voltage and impedance using A.C. potentiometer.
9. Calculation of iron losses using B-H curve with oscilloscope.
10. Localizing Ground and short circuit faults using Murray loop test and Varley loop test.
11. Measurement of relative permittivity (Ɛr) of a dielectric medium using Schering Bridge.
12. Measurement of frequency of unknown sinusoidal signal with CRO.
13. Measurement of phase and amplitude using CRO.
14. Calibration of given power factor meter using calibrated voltmeter, ammeter and wattmeter.

Note: At least ten experiments should be conducted in the Semester.

Suggested Reading:

1. Shawney A.K., Electrical and Electronics Measurements and Instruments, Dhanpatrai& Sons, Delhi, 2000.
2. Umesh Sinha, Electrical, Electronics Measurement & Instrumentations, Satya Prakashan, New Delhi.
3. Golding E.W., Electrical Measurements & Measuring Instruments, Sir Issac& Pitman & Sons Ltd., London.