MINORS IN ELECTRICAL ENGINEERING

SCHEME OF INSTRUCTION AND EVALUATION w.e.f. 2024-2025

S.No.	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits	Sem.
			L	T	P		Hrs	CIE	SEE		
Theory											
1	MR501EE	Electrical Circuits	3	-	-	3	3	40	60	3	V
2	MR601EE	Electrical Machines	3	-	-	3	3	40	60	3	VI
3	MR602EE	Electrical Measurement Techniques	3	-	-	3	3	40	60	3	VI
4	MR701EE	Elements of Electrical Power Systems	3	-	-	3	3	40	60	3	VII
5	MR702EE	Electrical Vehicles	3	-	-	3	3	40	60	3	VII
6	PW852EE	MR- Project Work	3	-	-	6	6	-	100	3	VIII
Total			**18**	**-**	**-**	**21**	**21**	**200**	**400**	**18**	

Course Code	Course Title						Course Type
MR 501 EE	ELECTRICAL CIRCUITS						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 Network theorems.
- To acquire knowledge in steady state analysts of three-phase AC circuits.
- To acquire the knowledge in transient and steady response of networks for AC and DC excitations by solving differential equations.
- To acquire knowledge in Laplace transform method of Analysis of Networks.
- To acquire knowledge in Two-port network parameters

Course Outcomes:

1. Apply network theorems to analyze networks.
2. Evaluate steady state behavior of three-phase AC networks.
3. Evaluate transient and steady response of networks for AC and DC excitations by solving differential equations.
4. Evaluate transient and steady response of networks for AC and DC excitations by Laplace transforms.
5. Obtain two port network 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				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 theorems: Mesh Analysis and Nodal Analysis, Dependent and Independent current and voltage sources, Superposition theorem for DC and AC circuits, Thevenin's theorem for DC and AC circuits, Nortons Theorem for DC and AC circuits, Maximum Power Transfer theorem for DC and AC circuits, Millmans theorem.

UNIT – II

Three-phase Circuits: Analysis of balanced and unbalanced 3-phase circuits, Star and delta connections, Measurement of three-phase power for balanced and unbalanced loads. Three phase power measurement and two-wattmeter method.

UNIT-III

Transient analysis: Solution of First and Second order networks , Solution of first and second order differential equations for Series and parallel R-L, R-C, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, Steady state and Transient Response of RL, RC and RLC networks subjected to DC and AC supply.

UNIT- IV

Laplace Transform Method of Analysis of Networks: Definition of Laplace pair, Evaluation of Laplace transform of common time function, Laplace properties and theorems, Convolution theorem, Partial fraction method of inverse transforms, Application to Networks, Transfer functions.

UNIT-V

Two port network parameters: Open circuit impedance, Short circuit admittance, Transmission, Hybrid parameters & inter-relationships, Series, parallel and cascade connection of two port networks, System function, Impedance and admittance functions

Suggested Reading:

1. William Hayt H, Kimmerly Jack E, Steven Durbin M, *Engineering Circuit Analysis*,McGraw Hill, 7th Edition, 2006.
2. Jagan N.C, Lakshrninarayana C., *Network Analysis*, B.S. Publications, 3rd Edition, 2019.
3. Chakravarthy A., *Circuit Theory Analysis and Synthesis*, Dhanpat Rai & Co., Seventh Edition, 2018
4. A Sudhakar, Shyammohan S Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 5 th Edition, 2017.
5. Van Valkenburg M.E., *Network Analysis*, Pearson education , 3rd Edition, 2019.

Course Code	Course Title					Course Type
MR 601 EE	ELECTRICAL MACHINES					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:

- Able to understand the DC generators and acquire the knowledge of construction, principle of operation and performance characteristics.
- Able to understand the DC motors and acquire the knowledge of performance curves, losses, efficiency and its applications.
- Able to understand the single phase transformers and acquire the knowledge of phasor diagrams, testing, regulation and efficiency.
- Able to understand the three phase induction motors and acquire the knowledge of principle of operation, characteristics, tests and its applications.
- Able to understand and acquire the knowledge of synchronous generator, construction, winding factors, synchronous impedance, regulation and synchronous motor operation and its applications.

Course Outcomes:

1. Acquire the knowledge of the DC generators, principle, construction, characteristics and applications.
2. Acquire the knowledge of DC motors, principle, performance curves, efficiency and testing.
3. Able to analyze the single phase transformers, phasor diagrams, testing, regulation and efficiency.
4. Acquire the knowledge of three phase induction motors, equivalent circuit, testing, starting methods and performance characteristics.
5. Acquire the knowledge of synchronous machines, windings, phasor diagrams, regulation, characteristics and applications.

Articulation matrix of Course Outcomes with POs:

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

UNIT-I

DC Generators: Simple loop generator, Essential parts of DC machine, Details of Lap winding and Wave winding, EMF equation, Armature reaction- Remedies, Ampere turns, Commutation-reactance voltage, Methods of improving commutation, shifting of brushes, Inter poles, Compensating winding. Classification and types of DC generators, Open circuit characteristics, Internal and External characteristics- Critical resistance and critical speed, Voltage regulation, Applications.

UNIT-II

DC Motors: Classification and 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 and four-point starters, Power losses- Copper losses and Rotational losses, Power flow, Efficiency, Swinburne's Test and Brake Test, Applications.

UNIT-III

Single Phase Transformers:

Constructional features of single phase transformers, principle of two winding transformer, ideal transformer-transformer on no-load and on-load, phasor diagrams-equivalent circuits, losses, Testing-Polarity test, OC and SC tests, Regulation and efficiency, All day efficiency, separation of losses and Applications.

UNIT-IV

Three-Phase Induction Motors:

Constructional features- Principle of operation - 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. Starting methods of 3-phase induction motor - Auto transformer, Star-Delta Starter.

UNIT – V

Synchronous Machines

Types and Constructional Details - Types of Winding, Winding factors - E.M.F. equation - Armature reaction and reactance - Synchronous impedance.

Synchronous Generators: Voltage Regulation - Phasor diagram of alternator with non-salient poles - O.C. and S.C. Characteristics- Synchronous impedance for finding regulation.

Synchronous Motors: Theory of operation - Vector diagram - Variation of current and p.f. with excitation - Hunting and its prevention - Applications.

Suggested Reading:

1. Kothari D.P. &Nagrath I.J. - Electrical Machines - Tata McGraw Hill, 2004.
2. Bhimbra P.S. - Generalized Theory of Electrical Machines, Khanna Publications, 2000.
3. Gupta J.B., Theory and Performance of Electrical Machines, S.K. Kataria &Sons, Delhi,2005
4. Say MG. - The Performance and Design of AC. Machines - Pitman Publication, 2002.
5. Irving L. Kosow - Electric Machinery and Transforn1ers, PPH, Pearson Education, 2nd Edition. 2009.

Course Code	Course Title						Course Type
MR 602 EE	ELECTRICAL MEASUREMENT TECHNIQUES						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 Outcomes:

1. Able to identify the applications of MI and PMMC ammeters & voltmeters.
2. Able to identify the applications of dynamometer type wattmeter & power factor meter.
3. Able to analyze the working errors & adjustments of energy meter.
4. Able to measure the R, L, C parameters with various bridges.
5. Able to identify the applications of CTs & PTs and able to measure voltage, phase & frequency with CRO.

UNIT-I: Introduction: Definitions: Accuracy, tolerance, sensitivity, reproducibility, absolute and secondary measuring instruments, indicating, recording and integrating instruments.

Analog Ammeters and Voltmeters: PMMC and MI instruments: construction, torque equation, range extension, advantages and disadvantages.

UNIT-II: Analog Wattmeter and Power Factor Meters: Electrodynamometer type wattmeter and power factor meter: construction, working, torque equation, advantages and disadvantages; Measurement of active and reactive power in single phase; Measurement in three phase.

UNIT-III: Analog Energy Meter: Single phase induction type energy meters, construction, working, lag adjustments, errors; Maximum demand indicators.

UNIT-IV: Electrical Bridges: DC bridges: Wheatstone, Kelvin's double bridge, Megger, Earth resistance measurement; AC bridges: Maxwell's, Anderson, Schering; Applications and limitations.

UNIT-V: Instrument Transformers: Construction, working, testing & applications of current transformer and potential transformer.
Electronic Instruments: CRO, measurement of voltage and frequency, Lissajous patterns.

Learning Resources:

Text Books:

1. A Course in Electrical Measurements, Electronic Measurements and Instrumentation, A. K. Sawhney, Dhanpat Rai and Co., 2015.

2. Modern Electronic instrumentation and Measurements Techniques, William D. Cooper, Albert D. Helfrick, Prentice Hall of India Pvt. Ltd. 2002.

3. Electrical and Electronics Measurements and Instrumentation, Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley, McGraw Hill Education (India) Private Limited, 2013.

Reference Books:

1. Electrical Measurements and Measuring Instruments, E.W. Golding, F.C. Widdis, Reem Publications, 2011.

2. Measurement Systems-Applications and Design, Ernest O. Doebelin, McGraw-Hill College, 4th edition, 1989.

Online Resources:

1. https://nptel.ac.in/courses/108/105/108105153