Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE201**	**Title of the Course**	**LINEAR NETWORK AND SYSTEMS**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**3rd**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To acknowledge the students about basic laws and theorems • To analyze the theoretical and practical values of given circuit • To know about transient state and steady state • To acknowledge the students about stability, two port network and graph theory						

Course Outcomes	
CO1	For a given network, would be able to apply the knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits, Identify, formulate, and solve engineering problems in the area electrical circuits & systems.
CO2	For a given system with dc and ac circuits, describe the different network theorems, would be able to apply, solve and verify the solutions using modern tools for lifelong learning like MATLAB.
CO3	For given a system with two port networks described in standard form, would be able to characterize, modeling, analyze, and verify the network in terms of all network parameters.
CO4	For given a system with RL, RC, and RLC circuits, would be able to understand, perform, formulate, and solve the differential equations for RL, RC, and RLC circuits and analyze the characteristics of the system.
CO5	For given a system description, would be able to explore and apply to alternate system description, and implement using basic blocks for network transfer function in s-domain and Two port networks.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Concept and AC Network theorems**	Kirchoff's law, Source transformation, loops analysis, node analysis, super mesh and super node. AC Network theorems: Superposition, Thevenin's, Norton's, Maximum power transfer theorem, Reciprocity, Substitution, Compensation, Millman's and Tellegen's theorem.	8	CO1
2	**Transient and steady state analysis**	Transient and steady state analysis for R-L, R-C and RLC circuits, Initial value and final theorem Use of Laplace transform in circuit analysis, Solution of differential equations. Lap lace transform of complex waveform.	8	CO2
3	**Network Synthesis**	Concept of poles and zeros, transfer function, Stability , Hurwitz Polynomial, Positive real function: Definitions and properties, Synthesis of RC, LC and RL Networks using Cauer and Foster I and II forms	8	CO3
4	**Two port networks**	Two port parameters, Inter-Conversion of two port Parameters, Interconnections of Two port networks, Reciprocity and Symmetry, T-pie transformation.	8	CO4
5	**Introduction to graph theory**	Definitions: Branch, Graphs, Tree, Co- tree, Path and Loop, Concept of Planner and non planner network, Incidence, Cut-set, Tie-set matrices for planer network. loop and nodal analysis.	8	CO5

Reference Books:

1. M.E.Van Valkenburg, Network Analysis, PHI
2. J.A.Edminister, Electric Circuits, Schaum Series, PHI
3. W.H. Hayt and Jack.E.Kammerly, Engineering Circuit Analysis, Tata Mc Graw Hill
4. A.Hussain, Network and Systems, Khanna publications

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	2	1		1	1	1		2	3	3	2	2		
CO2	3	2	3	3	2	2	1	2		1		1	3	3	3	2		
CO3	3	3	2	3	2	1							3	2	2	2		
CO4	3	2	2	3	1			1		1		1	3	3	2	2		
CO5	3	3	3	3	2	1		1		1			3	2	2	3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE203**	**Title of the Course**	**Electro Mechanical Energy Conversion I**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**3rd**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• Knowledge and concept of D.C Circuit Analysis and Network Theorems Circuit. • Use of Steady State Analysis of Single Phase AC Circuits AC fundamentals. • Knowledge and concept of Three Phase AC Circuits Three phase system and measuring devices. • Basic concepts of Power System and Transformer • Study of Electromechanical energy conversion devices: AC/ DC Machines.						

Course Outcomes	
CO1	Know about the concept of D.C Circuit Analysis and Network Theorems Circuit
CO2	Steady State Analysis of Single Phase AC Circuits AC fundamentals.
CO3	Know about concept of Three Phase AC Circuits Three phase system and measuring devices
CO4	Layout of Power System and transformer
CO5	Know about Electromechanical energy conversion devices: AC/ DC Machines

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Principle of Electromechanical Energy Conversion**	Introduction, Energy in electromagnetic system, Flow of energy in electromechanical devices, Energy in magnetic field and co-energy, Dynamics of electromechanical systems, singly excited systems, Doubly Excited. System.	8	CO1
2	**DC MACHINES**	Construction, function of commutator, simplex lap and wave windings, emf and torque equations, armature reaction and commutation,Remedial measures used for reducing commutation,D. C. generator characteristics	8	CO2
3	**DC MACHINES AND SPECIAL MACHINES**	Characteristics of dc motors, testing of dc machines, Hopkinson's test and Swinburne test, dc motor starters, speed control and braking of dc motors Special motors: universal motor, permanent magnet dc machines, hysteresis motor, reluctance motor, and stepper motor	8	CO3
4	**ELECTRICAL TRANSFORMER-I**	Principle of transformer action. Construction of two winding transformer, Equivalent circuits and phasor diagrams of Ideal and real transformers, Losses in transformers, Testing: open circuit, short circuit tests and Sumpner's test, per unit system, Efficiency and voltage regulation	8	CO4
5	**ELECTRICAL TRANSFORMER II**	Autotransformers: Introduction, Comparison with two winding transformers, Three phase transformer: Construction,phase groupings; Parallel operation, Phase transformation: Three phase to two-phase, single-phase, and six-phase, Application of different types of transformer	8	CO5

Reference Books:

1. Electric Machines, M.A.Mallick, IK International Pvt. Ltd New Delhi,2009
2. Electrical Machinery, Fitzgerald, Kingsley (McGraw Hill),6th Edition,2020
3. Electrical Machines and their Applications, J Hind Marsh,4th Edition,1984
4. Fundamental of Electrical Machines, B.R. Gupta & V. Singhal ,New Age International Pub.,2005
5. Electric Machinery and Transformers, I.L.Kosow, PHI,2007
6. Electrical Machine, I J Nagrath and D P Kothari ,TMH,2004

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	1	1	3						3	3	2	1	3		
CO2	3	3	3	2	1	1						2	3	2	2	2		
CO3	3	2	1	1	2	2	3					3	2	2	1	3		
CO4	3	2	2	2	3	3						2	3	3	1	2		
CO5	3	1	1	1	1	2	1					2	3	1	2	2		

2- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE205**	**Title of the Course**	**Solid State Devices & Circuit**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**3rd**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To analyze and designing concept of special purpose diodes and their industrial application. Understand the advancement in conductivity of semiconductors material. • To facilitate and understand the advancement in transistors like JFET, MOSFET, PMOS, NMOS, CMOS etc. and their various types' applications in Industries. Analyze the frequency response. • To develop and analyze the performance of small signal amplifiers and large signal amplifiers (Power amplifiers). • How to develop concept of feedback amplifiers, their different topologies and Implement it for various applications. To analyze their stability and their responses for different applications. • To analyze the design considerations of the active and passive filters. How to develop the various orders of filters and their industrial applications. To understand the constructional difference and working of various types of oscillators						

Course Outcomes	
CO1	Analyze and designing concept of special purpose diodes for different types of operation for industrial application purpose. Understand the advancement in conductivity of semiconductors material. Analysis the different regions in which BJT operates and their applications as a switches, amplifiers etc.
CO2	Understand the advancement in transistors like JFET, MOSFET, PMOS, NMOS, CMOS etc. and their various types' applications in Industries. Analyze the frequency response of these devices as different amplifier applications. To Understand how the gain of amplifier effected with frequency changes and their applications.
CO3	To develop and analyze the performance of small signal amplifiers and large signal amplifiers (Power amplifiers) . To understand and implement the various power amplifier in applications as transmitter and receiver in communication purpose.
CO4	Developing the concept of feedback amplifiers, their different topologies and Implement it for various applications. To analyze their stability and their responses for different applications.
CO5	To analyze the design considerations of the active and passive filters. How to develop the various orders of filters and their industrial applications. To understand the constructional difference and working of various types of oscillators. How the oscillators can be developed and their use in industries.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Diode and BJT**	Special Diodes, LED, Zener, Varactor, Schottky barrier, photo diode, and tunnel diode: their constructions and characteristics. Bipolar Junction Transistors, biasing of BJT, equivalent circuit, Transistor as a switch, cut off and saturation region, complete static characteristics of BJT, Darlington pair.	8	CO1
2	**FET and MOS**	Field Effect transistor: Structure and physical operation. Enhancement and depletion types MOSFET, Classification of MOS: NMOS, PMOS and CMOS I/V characteristics, Biasing of FET, Low and high frequency response of common source and common emitter configuration, Common base and Common gate cascade configurations, CC-CE cascade	8	CO2
3	**Amplifiers**	Small signal amplifiers: BJT and MOSFET, Frequency response improvement, Classification of amplifiers: Class A, Class B, Class C amplifiers, Power amplifiers, push pull amplifiers, DC amplifier, coupling methods.	8	CO3
4	**Feedback amplifiers**	Basic concept, General feedback structure, properties of negative feedback, four basic feedback topologies: series-series, series-shunt, shunt-series and shunt-shunt, determination of Loop gain, stability analysis, wave shaping circuits.	8	CO4
5	**Filters & Oscillators**	Active filters, Oscillators, condition for oscillation, Basic principles of sinusoidal oscillator, RC oscillators, Phase Shift oscillator, Wein bridge oscillator, Hartley and Colpitt's oscillator, Crystal Oscillator, Operational amplifier: Characteristics and application	8	CO5

Reference Books:

1. A.S. Sedra and K.C. Smith, "Microelectronic circuits", Oxford University Press (India). 2. B.P. Singh & R. Singh, Electronics Devices & Integrated Circuits, Pearson.

2. Millman, J. and Grabel, A., 'Microelectronics',/McGraw Hill.

3. Bell, David A,'Electronic Devices & Circuits',Prentice Hall (India) 4th Edition.

4. Nair, B. Somanathan, 'Electronics Devices & Applications',Prentice-Hall (India)

5. Neamen, Donald A., 'Electronic Circuit Analysis & Design',Tata McGraw Hill.

6. Sedra, 'Micro Electronics Circuits', Oxford University Press.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	3	3	1	1	1		2	2	2	2	2	2		
CO2	3	3	2	3	2	3	2						2	2	1	2		
CO3	3	2	3	2	2	2	1	1			1	1	2	3	2	2		
CO4	3	1	1	1	2	2	2						2	2	1	2		
CO5	3	1	1	1	2	2	2						2	3	1	3		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE207**	**Title of the Course**	**Fundamentals of EMFT**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**3rd**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To understand the students about Coordinates systems. To develop ability for analysis of three-dimensional space and obtain the solution of electromagnetic problems by Vector theorems and Operators. • To analyze the electrostatics problems by applying fundamental law's. • To realize and examine the magneto statics problems and response the behavior of magnetic fields in different magnetic materials • To recognize the concepts of Gauss Law and Maxwell equation by investigation in real time domain . To learn the Concepts of Displacement Current and Wave Propagation. • To execute the analysis of Guided Waves and transmission lines by various parameters and propagation constant						

Course Outcomes	
CO1	Given a physical quantity, students shall be able to represent this in vector and scalar form, identify type of system, apply vector algebra, and formulate the expression in different coordinates and solve using vector theorems.
CO2	Given a electrostatic problems of passive elements with sources, student shall be able to analyze and evaluate the problems using Gauss laws and Divergence theorem.
CO3	For a given magneto-static situation , student shall be able to generate its analytical response by Biot Savart's law and examine, analyze and evaluate the characteristics by Maxwell's Equation and Boundary Conditions
CO4	For a given Time varying function, students shall be able to identify its characteristics and for Wave Propagation , select suitable design of application of Maxwell's equation, develop various combination for Power by Pyonting Vector and explain the functions of its main components.
CO5	Given a Guided Waves and Transmission line, student shall be able to define its parameters, solve/ analyze, and modify its form

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit I**	Review of scalar and vector field, Co-ordinates systems and their transformation (Cartesian, cylindrical and spherical). Vector representation of surfaces, Del operator, Gradient of Scalar, Divergence of vector and Divergence theorem, Curl of vector and Stocks Theorem, Laplacian of Scalar.	8	CO1
2	**Electrostatic Fields**	Coulombs law and field Intensity, Electric flux density, Gauss's law and its application, Electric potential, Electric dipole and flux lines, Energy density. Introduction to conductors, Dielectrics polarization, Continuity equation, boundary conditions, Poisson's and Laplace's equation.	8	CO2
3	**Magneto-static Fields**	Biot-Savarts Law, Ampere's circuit law, Magnetic flux density, Magnetic scalar and vector potentials. Force due to magnetic fields, Lorentz-force equation, Magnetic torque and moment Magnetization in material, Boundary conditions, Energy density.	8	CO3
4	**Time-Varying Fields & Wave propagation**	Faraday"s law, displacement current, Maxwell's equation in integral and point form, Time varying potential, Time Harmonic Fields. Propagation of uniform plane waves in free space, dielectric and conductors, Pyonting theorem and power flow, Reflection of plane wave at Normal Incidence.	8	CO4
5	**Guided waves & Transmission line**	Introduction to guided waves, Rectangular waveguide. Transmission line parameter, Transmission line equations, Characteristic impedance, propagation constant (for lossless lines and Distortion-less lines), Input impedance, reflection coefficient, Standing wave ratio and Power. Open and short circuited lines.	8	CO5

Reference Books:

1. Elements of Electromagnetics- "M.N.O. Sadiku", oxford University Press
2. Electromagnetic waves and Radiating systems- E.C.Jorden, D.G.Balmein
3. Engineering Electromagnetics- "W.H.Hayt & J.A. Buck", TMH.
4. Electromagnetic- J.F.D.Kraus, R.C.Keith

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	1	2	1							2			2		
CO2	3	3	1	1	2								1	2	1	2		
CO3	3	3	1	1	2								1	3		2		
CO4	3	3	1	1	2							1	1	2		2		
CO5	3	3	2	2	2		1	1					2	3		3		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE209**	**Title of the Course**	**Electrical Measurement & Measuring Instruments**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**3rd**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To understand the measurement system, measurement methods and errors, measurement of electrical quantities To understand three phase power measurement; working of thermocouple, electrostatic and rectifier type instruments; energy meter and instrument transformer To understand measurement of low, medium and high resistances, use of ac bridges and Q meter To understand use of ac potentiometer; measurement of speed, frequency and power factor To understand digital measurement of electrical quantities; CRO and its application						

Course Outcomes	
CO1	Adopt the methods of measurement, investigate the errors in measurement, analyze and rectify; perform analog measurement of electrical quantities; contribute in related development
CO2	Perform three phase power measurement; use thermocouple, electrostatic, rectifier type instruments, energy meter and instrument transformer for measurement; identify errors in energy meter and adopt remedies; adopt extension of instrument range using instrument transformer; contribute in related development
CO3	To perform measurement of low, medium and high resistances; perform measurement of inductance and capacitance using ac brides; adopt use of Q meter, contribute in related development
CO4	To adopt use of ac potentiometer; perform measurement of speed, frequency and power factor; contribute in related development
CO5	To perform digital measurement of electrical quantities; adopt application of CRO, dual trace and dual beam oscilloscopes; contribute in related development

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Unit I**	Philosophy of measurement: Methods of measurement, measurement system, classification of instrument system, characteristics of instrument and measurement system, error in measurement and its analysis. Analog measurement of electrical quantities: PMMC type Instruments, Moving Iron type Instruments, Electrodynamics type Instruments' three phase wattmeter, error and remedies in wattmeter.	8	CO1
2	**Unit II**	Power measurements in three phase system, Thermocouple, electrostatic and rectified type ammeter and voltmeter, Energy meter, error and remedies in energy meter. Instrument transformer and their application in the extension of instruments range.	8	CO2
3	**Unit III**	Measurement of parameter: Different methods of measurement of low, medium and high resistances, measurement of inductance and capacitance with the help of AC bridges, Q-meter.	8	CO3
4	**Unit IV**	AC Potentiometer: Polar type and co-ordinate type AC potentiometer, application of AC potentiometers in electrical measurement. Measurement of speed, frequency and power factor.	8	CO4
5	**Unit V**	Digital measurement of electrical quantities: concept of digital measurement, block diagram, study of digital voltmeter, frequency meter, Cathode ray oscilloscope: Basic CRO circuit (block diagram), cathode ray tube (CRT), and its components, application of CRO in measurement, Lissajous pattern, Dual trace and dual beam oscilloscopes.	8	CO5

Reference Books:

1. E.W. Golding & F.C. Widdis, "Electrical measurement & Measuring Instrument", A. W. Wheeler & Co. Pvt. Ltd. India.
2. A.K. Sawhney, "Electrical &Electronics Measurement & Instrument", Dhanpat Rai &Sons, India.
3. M.B. Stout ,"Basic Electrical Measurement" Prentice hall of India, India.
4. Forest K. Harries," Electrical Measurement", Willey Eastern Pvt. Ltd. India.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	2	3							2	2	2		3		
CO2	3	3	1	2	3							2	2			3		
CO3	3	1	1		3							2	2			3		
CO4	3	1	1		3							2	2			3		
CO5	3	1	1		3							2			2	3		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE 202**	**Title of the Course**	**Network Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**2**	**1**
Pre-Requisite	EE103	**Co-requisite**	NIL				
Course Objectives	• To acknowledge the students about basic laws & Theorems. • To analyze the theoretical & practical values of given circuit. • To know about transient state and steady state. • To acknowledge the students about stability, two-port network and graph theory.						

Course Outcomes	
CO1	Adopt, perform, analyze and implement the methods of measurement of electrical quantity of Theorems by Multimeter; contribute in related development
CO2	Adopt, perform, analyze and implement the methods of measurement of electrical quantity of RC , RL and RLC circuit byCRO; contribute in related development
CO3	Adopt, perform, analyze and implement the methods of two-port networks; contribute in related development
CO4	For given a system with RL, RC, and RLC circuits, would be able to understand, perform, formulate, and solve the differential equations for RL, RC, and RLC circuits and analyze the characteristics of the system.

Exp. No.	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1	To verify Superposition theorem for dc network	2	1
2	To verify Thevenin's theorem for dc network	2	1
3	To verify Tellegen's theorem for dc network	2	1
4	To verify Maximum power transfer theorem for dc network	2	1
5	To study transient response of RC series circuit	2	2,4
6	To study frequency response of RLC series circuit	2	2,4
7	To determine the h-parameter of a port resistive network	2	3
8	To determine the z-parameter of a port resistive network	2	3
9	To determine the ABCD-parameter of a port resistive network	2	3
10	To study transient response of RLC series circuit	2	2,4

Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", Chaukhamba Auriyantaliya Publication, 3rd Edition, 2010.
2. J. A. Edminister, "Electric Circuits", Schaum Outline Series, McGraw Hill Education; 5th edition, 2017.
3. W. H. Hayt and Jack E. Kammerly, "Engineering Circuit Analysis", McGraw Hill Education;Eighth edition, 2013.
4. A. Hussain, "Network and Systems", Khanna Book Publishing Co. (P) Ltd.; Second edition, 2019.

e-Learning Source:

PO-PSO	**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	1		1	1	1		2	2	3	3	3
CO2	3	2	3	3	2	2	1	2		1		1	2	3	3	3
CO3	3	3	2	3	2	1							2	3	3	1
CO4	3	2	2	3	1			1				1	2	3	3	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE 204**	**Title of the Course**	**Electromechanical Energy Conversion-I Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Understand the principles of operation of starters used in dc machines • Perform the speed control of different dc machines • Evaluate the performance of dc machines and transformers • Perform testing of dc machines and transformers						

Course Outcomes	
CO1	Knowledge of different starters used in dc machines
CO2	Perform speed control of dc motor
CO3	Determine the losses in transformers using OCT, SCT and Sumpner's test
CO4	Determine the performance of DC machines and transformers

Exp. No.	**Title of the Unit**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		To study three point starter	2	1
2		To obtain and plot magnetization characteristic of dc shunt generator.	2	4
3		To obtain characteristic of a dc shunt generator.	2	4
4		To obtain load characteristic of a dc compound generator	2	4
5		To study speed control of a dc shunt motor.	2	2
6		To obtain load characteristic of dc series generator.	2	4
7		Polarity test of single phase transformer	2	3
8		Parallel operation of D.C Generators.	2	4

Reference Books:

1. V. Deltoro, "Principle of Electrical Engg.", PHI, 2009
2. M. A. Mallick, Dr. I. Ashraf, "Fundamental of Electrical Engg,", CBS Publishers, 2010.
3. A. Hussain, "Basic Electrical Engg.", Dhanpat Rai & Sons, 2007
4. I. J. Nagrath, "Basic Electrical Engg.", TMH, 2010.

e-Learning Source:

v-lab (IIT Roorkee Website)

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	2	2	3	1
CO2	3	3	1	2	3							2	2		1	1
CO3	3	1	1		3							2	2	3		1
CO4	3	1	1		3							2	2		3	1

3- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE 206**	**Title of the Course**	**SSDC Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	To develop knowledge and application of fundamental electronic circuits and physical electronics of some key semiconductor devices, including design, construction and testing of experimental electronic circuits.						

Course Outcomes	
CO1	To designing concept of special purpose diodes for different types of operation for industrial application purpose. Understand the advancement in conductivity of semiconductors material. Analysis the different regions in which BJT operates and their applications as a switch, amplifiers etc..
CO2	Understand the advancement in transistors like JFET, MOSFET, PMOS, NMOS, CMOS etc. and their various types' of applications in Industries. Analyze the frequency response of these devices as different amplifier applications. To Understand how the gain of amplifier effected with frequency changes and their applications.
CO3	Developing the concept of feedback amplifiers, their different topologies and implement it for various applications. To analyze their stability and their responses for different applications.
CO4	To analyze the design considerations of the active and passive filters. How to develop the various orders of filters and their industrial applications. To understand the constructional difference and working of various types of oscillators. How the oscillators can be developed and their use in industries.

Exp. No.	**Title of the Unit**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		Study of Clipping circuit and Clamping circuit	2	3
2		Study of LED (Red, Green, Yellow)	2	1
3		Study of single stage RC coupled transistor amplifier	2	2
4		Study of Emitter follower circuit and determine and determine a) Maximum signal handling capacity at 1 KHz at no load b) Plot frequency response at no load	2	1
5		Study of Wein's Bridge oscillator a) Determine the frequency of oscillation b) Determine the value of unknown capacitance C_x	2	4
6		Application of operation amplifier as Inverting, Non- Inverting, and unit gain amplifier(buffer).	2	3
7		Application of an operational amplifier as a differentiator and integrator. Plot frequency response	2	3
8		Study of MOSFET, plot V-I characteristics of N-MOS and P-MOS, find r_d,g_m and draw equivalent circuit.	2	2
9		Study of Clipping MOSFET as an amplifier (CS)	2	2
10		Study of Differential Amplifier using BJT	2	3

Reference Books:

1. VBell, David A/ "Electronic Devices & Circuits"/Prentice Hall (India) 4th Edition.
2. A.S. Sedra and K.C. Smith, "Microelectronic circuits", Oxford University Press (India).
3. Millman, J. and Grabel, A./" Microelectronics"/McGraw Hill.
4. Neamen, Donald A./ "Electronic Circuit Analysis & Design"/Tata McGraw Hill.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	2	2	3	1
CO2	3	3	1	2	3							2	2		1	1
CO3	3	1	1		3							2	2	3		1
CO4	3	1	1		3							2	2		3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE 208**	**Title of the Course**	**ELECTRICAL WORKSHOP LAB**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	III	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To understand and experiment with the measurement of Electronic Circuits and systems. • To understand and experiment with the Semiconductor devices and integrated circuits. • To understand and experiment with Transformer assembly. • To understand Printed Circuit Board and Preparation of PCB.						

Course Outcomes	
CO1	Adopt, perform, analyze and implement the methods of components of Electronic Circuits and systems.
CO2	Adopt, perform, analyze and implement the concepts of Transformer, Chokes, Potentiometer.
CO3	Adopt, perform, analyze the Semiconductor devices and integrated circuits.
CO4	Adopt, perform, and implement the designing of Printed Circuit Board (PCB) and related development

Exp. No.	**Title of the Unit**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		To study the components of Electronic Circuits and systems. Types according to construction, rating and tolerance of Resistors, Capacitors, Inductors.	2	1
2		Study of Transformer, Chokes, Potentiometer, Switches and Rectifiers.	2	2
3		To study Semiconductor devices and integrated circuits: different rating and packages. Power Semiconductor devices and Heat Sinks.	2	3
4		To perform winding of Transformer, assembly of core and complete the transformer and also explain the various materials involved in it.	2	2
5		Preparation of Printed Circuit Board (PCB) and perform drilling on the PCB.	2	4
6		To perform soldering of components on the PCB and assembled circuit.	2	2
7		To perform Assembly of Electronic Circuits and Systems- Soldering and Communication Cable jointing. Bread Board Assembly of a regulated d.c. power supply.	2	3
8		Assembling of an unregulated DC power supply in a steel cabinet along with complete wiring.	2	4
9		Mini project (I): Stair case wiring.	2	4
10		Mini project (II): Core type transformer winding.	2	4

Reference Books:

1. R.P Singh Electrical Workshop, I.K. International Publishing House Pvt. Limited, 2005
2. A Textbook of Electrical Workshop Practices ,S.K. Kataria & Sons: 2019
3. P. S. Bimbhra Electrical Machinery : Dhanpat Rai & sons, 2007
4. I J Nagrath,"Basic Electrical Engg" ,TMH, 2010.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	2	2		3
CO2	3	3	1	2	3							2	2			3
CO3	3	1	1		3							2	2			3
CO4	3	1	1		3							2	2			3

4- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE211**	**Title of the Course**	**Electro Mechanical Energy Conversion II**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**4th**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• Knowledge of principle of operation of three phase ac motors • Identify different ac motors on the basis of characteristics • Analyze different ac machines • To evaluate the performance of ac machines • Knowledge of parallel operation of ac generators						

Course Outcomes	
CO1	Knowledge of different types of three phase induction machines
CO2	Analyze the induction machines performance under loading condition
CO3	Evaluate the performance of single phase ac machines
CO4	Knowledge of three phase synchronous machines
CO5	Evaluate the performance of synchronous machines

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**INDUCTION MACHINE I**	Electro-mechanical energy conversion principles: Force and EMF production in a rotating machine Classification of rotating machine; 3-phase Induction Machines: Types, construction,Introduction to windings and winding factor	8	CO1
2	**INDUCTION MACHINE II**	Production of revolving magnetic field, working principle on 3-phase induction machine, equivalent circuit, phasor diagram, Losses and power flow diagram, slip-torque curves, no load and blocked rotor tests, starting methods, speed control	8	CO2
3	**SELECTED TOPICS IN ELECTRICAL MACHINES**	Space harmonics, effects of space harmonics; cogging, crawling, and noise. Single-phase induction motors: Principle of operation; double revolving field and cross field theories; equivalent circuit and torque-speed characteristics; Starting methods of single-phase induction motors: split-phase and shaded pole motors. Induction generator and its applications	8	CO3
4	**SYNCHRONOUS MACHINES- I**	Construction, armature reaction and two reaction theory, synchronous reactance and phasor diagram, expression for power developed and power angle curve for salient and non-salient pole machines, maximum power. Open circuit, short circuit and zero power factor tests, Alternator load characteristics. Voltage regulation and its determination by synchronous impedance and Potier triangle method.	8	CO4
5	**SYNCHRONOUS MACHINES- II**	Synchronization of three phase alternators, effect of governor characteristics on load sharing of alternators, operation on infinite bus bars, active and reactive power control. Synchronous motors: methods of starting, synchronizing power, hunting, V-curves, synchronous condenser	8	CO5

Reference Books:

1. D.P. Kothari & I.J. Nagrath , 'Electric Machines', Tata Mc Graw Hill,2004.
2. Ashfaq Hussain ,'Electric Machines', Dhanpat Rai & Company,2010.
3. Fitzerald ,A.E., Kingsley and S.D.Umans, 'Electric Machinery', MC Graw Hill,2014.
4. P.S.Bimbhra, 'Electrical Machinery', Khanna Publishers,2003
5. P.S. Bimbhra, 'Generalized Theory of Electrical Machines', Khanna Publishers ,1995
6. M.G.Say, 'Alternating Current Machines', Pitman & Sons,3rd Edition, 1995.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1									2		2	3		
CO2	3	2		1									2	3	2	2		
CO3	3	1										2	2	3	2	3		
CO4	3	2										1	2	3	2	3		
CO5	3	2					1						2	3	3	2		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE213**	**Title of the Course**	**Numerical Analysis and Applications**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**4th**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To provide suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems. • To solve problems in the field of applied mathematics, theoretical physics and engineering which requires computing of numerical results using certain raw data. • To solve complex mathematical problems using only simple arithmetic operations. The approach involves formulation of mathematical models of physical situations that can be solved with arithmetic operations. • To deal with various topics like finding roots of equations, solving systems of linear algebraic equations, interpolation and regression analysis, numerical integration & differentiation, solution of differential equation, boundary value problems, and solution of matrix problems. • To facilitate numerical computing.						

Course Outcomes	
CO1	Apply Numerical analysis which has enormous application in the field of Science and some fields of Engineering.
CO2	Describing and understanding of the several errors and approximation in numerical methods.
CO3	The explaining and understanding of the several available methods to solve the simultaneous equations by modern IT tools.
CO4	To solve problems in the field of applied mathematics, theoretical physics and engineering which requires computing of numerical results using certain raw data by using modern tools and follow the ethical rules.
CO5	To deal, communicate and environment sustainability with various topics like finding roots of equations, solving systems of linear algebraic equations, interpolation and regression analysis, numerical integration & differentiation, solution of differential equation, boundary value problems, and solution of matrix problems in the field of Engineering and modern life.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Errors and approximations**	Error definitions, accuracy and precision, round off and truncation errors **Roots of equations**- Solution of Algebraic and Transcendental equations, Newton- Raphson method, Secant method, Bisection method, Fixed Iteration method, Regula-Falsi method. **Finite differences**- Forward differences, Back ward differences, Central differences.	8	CO1
2	**Solutions of simultaneous linear algebraic equations**	Gauss elimination method, Gauss-Jordan method, Matrix inversion method, LU decomposition methods, iterative method: Gauss-Seidel, Jacobi's method	8	CO2
3	**Curve fitting**	Introduction, method of least square, fitting of a straight line by method of least square, change of origin and scale, normal equations for different form of curve. Interpolation with equal and unequal intervals: Newton's Gregory forward interpolation, Newton's Gregory backward interpolation, Newton's divided difference interpolation, Lagrange's interpolation	8	CO3
4	**Numerical differentiation**	Newton's Gregory forward interpolation formula to get derivatives, Newton's Gregory backward interpolation formula to get derivatives, Newton's divided difference interpolation formula to get derivatives, Lagrange's interpolation formula to get derivatives Numerical integration: Newton-cotes quadrature formula, Trapezoidal rule, Simpson's rule, Boole's rule, Weddle's rule	8	CO4
5	**Numerical solutions for ordinary differential equations**	Initial and Boundary value problems, Picard method of successes approximation, Taylor's series method, Euler's method, Modified Euler method, Runge-Kutta Method (First, second, third and fourth order)	8	CO5

Reference Books:

1. Josef Stoer and R. Bulirsch, "Introduction to Numerical Analysis" *Springer Science & Business Media*, ISBN 978-1-47575-592-3, Third Edition, 2013.

2.Lloyd N. Trefethen and David Bau III, "Numerical Linear Algebra", *Society of Industrial and Applied Mathematics*, ISBN: 978-0-898713-61-9, Illustrated edition, 1997.

3.C. T. Kelley, "Iterative Methods for Linear and Nonlinear Equations" , Frontiers in Applied Mathematics, Society for Industrial and Applied Mathematics, Philadelphia, ISBN:978-0-89871-352-7, 1995.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1									1		1	2		
CO2	3	2					1							2		2		
CO3	3	1										2		2		3		
CO4	3	2										1	2		2	2		
CO5	3	2					1							3		2		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE217**	**Title of the Course**	**Signal System Analysis**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**4th**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• Demonstrate an understanding of the fundamental properties of linear systems • Uses of transform analysis and convolution, to analyze and predict the behavior of linear time invariant systems						

Course Outcomes	
CO1	Understand mathematical description and representation of continuous and discrete time signals and systems.
CO2	Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
CO3	Understand and resolve the signal in frequency domain using Fourier series and Fourier transforms.
CO4	Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain
CO5	Analyze the discrete time signals and system using DTFT, DFT and Z

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Formalizing Signals**	Continuous-time/discrete-time, Periodic/non-periodic, even/odd, energy/power, deterministic/ random, Unit step, Unit ramp, Unit impulse, Sinusoid, complex exponential signals. **Signal Properties:** Periodicity, absolute integrability, determinism and stochastic character. **System properties:** Linearity, additivity and homogeneity, Scaling, shift invariance, causality. **Continuous and discrete time linear shift invariance system:** The impulse response and step response, convolution, input-output behavior.	8	CO1
2	**Fourier Transform Analysis**	Fourier series representation, Exponential and compact trigonometric form of Fourier series, Fourier symmetry, Fourier Transform, convolution/ multiplication and their effect in frequency domain, magnitude and phase response, Fourier domain duality, inverse Fourier transform, Application to circuit analysis, Dirichlet's condition.	8	CO2
3	**Discrete Fourier Transform**	Discrete time Fourier transform (DTFT), Discrete Fourier transform (DFT), Parsevals theorem, properties convergence, Sampling theorem and its implication, Reconstruction: Ideal interpolator, zero order hold, aliasing and its effect, Relation between continuous and discrete time system.	8	CO3
4	**Laplace Transform**	Laplace Transform for continuous time signals and systems: The notion of Eigen function of LSI system, region of convergence, system functions, poles and zeros of system functions and signals Convolution theorem, Laplace domain analysis, Waveform synthesis, solution to differential equation and system behavior.	8	CO4
5	**Z-Transform Analysis**	Z Transform for discrete time signal and system, Eigen function , region of convergence ,system function, poles and zeroes of system sequences, Z domain analysis, solution of difference equation, pulse transfer function	8	CO5

Reference Books:

1. S.H. Saeed, Faizan Arif Khan, "Basic System Analysis'' 2nd Edition, Katson Publishing Delhi.
2. A.V. Oppenhiem, A.S. Wilsky and I.T. young, "Signals & Systems", Prentice Hall, 1983
3. M E Van-Valkenberg; "Network Analysis", Prentice Hall of India.
4. B. P. Lathi, "Linear Systems & Signals" Oxford University Press, 2008.
5. I. J. Nagrath, S.N. Saran, R. Ranjan and S. Kumar, "Signals and Systems", Tata Mc. Graw Hill

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3		2		1			1	1		1	2			3		
CO2	3	3	2	2					1	1		1		2		2		
CO3	3	3	2	2		1			1	1		1			2	2		
CO4	3	3	2	2		1			1	1		1		2		2		
CO5	3	3	2	2		1	1		1	1		1		2		2		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE221**	**Title of the Course**	**Electrical Engineering Materials**	**L**	**T**	**P**	**C**
Year	**2nd**	**Semester**	**4th**	3	1	0	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To apply the knowledge of material science engineering. • To understand the impact of realistic constraints such as economic, environmental, safety, reliability, manufacturability and sustainability. • To know the properties of conducting, insulating, dielectric and magnetic materials from electrical engineering point of view. • To realize the potential of semiconducting devices with their application. • To learn latest techniques, skills, and modern engineering tools necessary for electrical engineering fabrication processes.						

Course Outcomes	
CO1	To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances, devices, instruments and in the applications associated with generation, transmission and distribution of electric power.
CO2	To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances, devices, instruments and in the applications associated with generation, transmission and distribution of electric power.
CO3	To provide students with a moderate level understanding of the physics behind the semiconductors.
CO4	To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances , devices , instruments and in the applications associated with generation, transmission and distribution of electric power.
CO5	An understanding of the electrical engineering material science essential for them to work in different fabrication based industries and also motivate them to do innovative characterization based research while going for higher studies and also to work in R & D with scientific enthusiasm

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Classification of Materials**	Metals and alloys, polymers, conducting materials, characteristic of good conductors, commonly used conducting materials, smart materials, fuel cell, super alloys, memory alloys, degradation of materials, .	8	CO1
2	**Dielectrics, Insulating and Conducting Materials**	Dielectric strength, factor affecting strength, polarization, dielectric loss, Types of capacitor, Insulating & Dielectric Materials - Properties of insulating materials, classification of insulating materials, Piezoelectricity, Ferro electricity, Principle and Applications of Optical Fiber, Material for OH lines and UG cables, Fuse, soldering, Effect of temperature on transformer oil	8	CO2
3	**Semiconductors and their Applications**	Types of semiconductor, direct and indirect band gap, semiconductor application and advantages of semiconducting devices, photo conducting cell, Hall effect generator, MHD generator, LEDs, photodiode, Introduction to LCD .	8	CO3
4	**Magnetic Materials and their Applications**	Basic concepts and definitions, origin of magnetism, dia, Para, Ferro, anti Ferro, ferri magnetism, Curie Temperature, Hysteresis and its significance, soft and hard magnetic materials, ferrites, silicon steel, their properties and uses, magnetic resistance.	8	CO4
5	**Fabrication and Characterization of Materials**	Planar process,, lithography, etching, spin coating, sputtering, CVD, carbon nanotube, nanowires (synthesis, properties and applications), Material characterization techniques such as scanning electron microscopy, transmission electron microscopy, Scanning tunneling microscopy, atomic force microscopy, differential scanning calorimetry.	8	CO5

Reference Books:

1. A. J. Dekker, Electrical Engineering Materials, PHI.
2. C.S Indulkar & S.Thiruvegada, An introduction electrical Engg Materials, S. Chand & Co.
3. S.O Kasap, Principles of Electronic Materials & Devices, TMH
4. L.V Azaroff, Introduction to Solids, Mc Grow Hill Company
5. Charles Kittle, Quantum theory of Solids, John Wiley and Sons

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)																	
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2		1									2	3		1		
CO2	3	2											3	3		1		
CO3	3	2		2								3	1	3		1		
CO4	2	1										3	2	2		2		
CO5	3		3									1	3	3				

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE 210**	**Title of the Course**	**Electrical Measurement Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To understand and experiment with the measurement of electrical quantity by DC Bridge • To understand and experiment with the measurement of electrical quantity by AC Bridge • To understand and experiment with the calibration of voltmeter • To understand and experiment with the calibration of ammeter						

Course Outcomes	
CO1	Adopt, perform, analyze and implement the methods of measurement of electrical quantity by DC Bridge; contribute in related development
CO2	Adopt, perform, analyze and implement the methods of measurement of electrical quantity by AC Bridge; contribute in related development
CO3	Adopt, perform, analyze and implement the methods of calibration of voltmeter; contribute in related development
CO4	Adopt, perform, analyze and implement the methods of calibration of ammeter; contribute in related development

Exp. No.	**Title of the Unit**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		Measurement of Low Resistance by Kelvin's Double Bridge	2	1
2		Measurement of Self-Inductance by Maxwell's Bridge	2	2
3		Measurement of Self-Inductance by Hay's Bridge	2	2
4		Measurement of Capacitance by Schering's Bridge	2	2
5		Measurement of Capacitance by De Sauty's Bridge	2	2
6		Measurement of Frequency by Wein's Bridge	2	2
7		Calibration of Voltmeter	2	3
8		Calibration of Ammeter	2	4

Reference Books:

1. V.Deltoro, "Principle of Electrical Engg." PHI, 2009
2. M.A Mallick, Dr. I. Ashraf, "Fundamental of Electrical Engg," CBS Publishers, 2010.
3. A. Hussain, "Basic Electrical Engg" Dhanpat Rai & sons, 2007
4. I J Nagrath,"Basic Electrical Engg" ,TMH, 2010.

e-Learning Source:

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	2	2		3
CO2	3	3	1	2	3							2	2			3
CO3	3	1	1		3							2	2			3
CO4	3	1	1		3							2	2			3

5- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2016-17							
Course Code	**EE 212**	**Title of the Course**	**Electromechanical Energy Conversion II Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Understand the principle of operation of different AC starters used in AC machines starting • Perform testing of three phase induction motor • Perform speed control of AC motors • Evaluate the performance of AC machines						

Course Outcomes	
CO1	Analyze and operate different starters used for starting AC motors
CO2	Knowledge of principle of operation of single phase and three phase induction motors
CO3	Evaluate the performance of single phase and three phase induction motors
CO4	Analyze the performance of synchronous generators and synchronous motors

Exp. No.	**Title of the Unit**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1		To study DOL and Star Delta starter.	2	1
2		To Study the operation of three phase Slip Ring Induction Motor.	2	2
3		To study single phase capacitor start induction motor and observe (a) effect of capacitor (b) reversal of direction of induction motor.	2	3
4		No load test and Blocked Rotor Test on Three Phase Induction Motor	2	3
5		To study of synchronization of an alternator by two bright method & one dark lamp method.	2	4
6		To study speed control of 3 phase squirrel cage induction motor using stator voltage control.	2	3
7		To obtain V- curve and inverted V curve of synchronous motor	2	5
8		To study speed control of three phase squirrel cage induction motor by frequency variation method.	2	3

Reference Books:

1. V. Deltoro, “Principle of Electrical Engg.”, PHI, 2009
2. M. A. Mallick, Dr. I. Ashraf, “Fundamental of Electrical Engg.”, CBS Publishers, 2010.
3. A. Hussain, “Basic Electrical Engg.” Dhanpat Rai & Sons, 2007.
4. I. J. Nagrath, “Basic Electrical Engg.”, TMH, 2010.

e-Learning Source:

Virtual Lab ,IIT Roorkee

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)															
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3									3	2	2		
CO2	3	2	3									3	2		3	
CO3	3	1	3									3	2	3		
CO4	3	1	3									3	2			3

6- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Integral University, Lucknow

Effective from Session: 2022-23							
Course Code	**EE 214**	**Title of the Course**	**Numerical Analysis and Applications Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• To provide suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems. • To solve problems in the field of applied mathematics, theoretical physics and engineering which requires computing of numerical results using certain raw data. • To solve complex mathematical problems using only simple arithmetic operations. The approach involves formulation of mathematical models of physical situations that can be solved with arithmetic operations. • To deal with various topics like finding roots of equations, solving systems of linear algebraic equations, interpolation and regression analysis, numerical integration & differentiation, solution of differential equation, boundary value problems, and solution of matrix problems.						

Course Outcomes	
CO1	Adopt, perform, analyze and implement the methods of simulation and programming of roots of equation by MATLAB; contribute in related development
CO2	Adopt, perform, analyze and implement the methods of simulation and programming of linear algebraic equation byMATLAB; contribute in related development
CO3	Adopt, perform, analyze and implement the methods of simulation and programming of numerical integration and differentiation by MATLAB; contribute in related development
CO4	Adopt, perform, analyze and implement the methods of simulation, programming and plot of equation by MATLAB;contribute in related development

Exp. No.	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1	Study the overview of MATLAB and basic mathematical operations.	2	1
2	Find the determinants and inverse of given matrix [A] using MALAB.	2	1
3	Solve the linear algebraic equations by using MATLAB. 5x=3y-2z+10; 8y+4z=3x+20; 2x+4y-9z=9	2	2
4	Find the Eigen value & Eigen vectors of a given matrix A by using MATLAB.5x-3y+2z=10; -x+8y+4z=20; 2x+4y-9z=9	2	2
5	Plot the raw data to do fit linear curve and display the equation by using MATLAB. X= [5 10 20 50 100]Y= [15 33 53 140 301]	2	2,4
6	Solve the transcendental equation Sin $x=e^x$-5 & plot it by using MATLAB.	2	2,4
7	Evaluate function by Simpson's 1/3 rule using MATLAB.	2	3
8	Evaluate function by Simpson's 3/8 rule using MATLAB.	2	3
9	Find the roots & plot the error of the given f(x) $=x^3$-x-1 by Bisection method using MATLAB.	2	2,4
10	Find the root of the following equation's using Gauss Seidel Method.20x+y-2z=17; 3x+20y-z=18; 2x-3y+20z=25	2	2

Reference Books:

1. Josef Stoer and R. Bulirsch, "Introduction to Numerical Analysis" Springer Science & Business Media, ISBN 978-1-47575-592- 3, Third Edition, 2013.

2. Lloyd N. Trefethen and David Bau III, "Numerical Linear Algebra", Society of Industrial and Applied Mathematics, ISBN: 978-0-898713-61-9, Illustrated edition, 1997.

3. C. T. Kelley, "Iterative Methods for Linear and Nonlinear Equations" , Frontiers in Applied Mathematics, Society for Industrial and Applied Mathematics, Philadelphia, ISBN:978-0-89871-352-7, 1995.

e-Learning Source:

https://drive.google.com/drive/folders/1i52ieww0iq_YlYw7 7lX4q6RGHpP97B_u?usp=sharing

PO-PSO	**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**															
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2									1	3	1	3
CO2	1	3	3	1	1								1	3	1	3
CO3	2	1	3	3	3	1			1		1	1	2	3	2	2
CO4	3	2	1	1	3	1		2	1		1	1	2	3	2	2

1-**Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**