Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE201**	**Title of the Course**	**Network Analysis**	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**2**	**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.

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Concept and AC Network theorems**	**Concepts:** 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, Millman's and Tellegen's theorem.	8	CO1
2	**Transient and steady state analysis**	**Transient and steady state analysis:** R-L, R-C and RLC circuits, Initial value and final theorem Use of Laplace transform in circuit analysis, 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, Incidence, Cut-set, Tie-set matrices for planer network. loop and nodal analysis.	8	CO5

PRACTICAL

S. No.	List of Experiments	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, PHI Learning Private Limited, 3rd Edition, 2014.
2. J.A. Edminister, Electric Circuits, Schaum Series, PHI Learning Private Limited, 7th Edition, 2018.
3. W.H. Hayt and Jack. E. Kammerly, Engineering Circuit Analysis, Tata Mc Graw Hill, 8th Edition, 2013.
4. A. Hussain, Network and Systems, Khanna publications, 2nd Edition, 2019.

e-Learning Resources:

1. https://nptel.ac.in/courses/117106116

2.	https://archive.nptel.ac.in/courses/108/106/108106150/
3.	https://aplicaciones.uc3m.es/cpa/generaFicha?est=217&plan=442&asig=13841&idioma=2
4.	https://archive.nptel.ac.in/courses/108/106/108106075/

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE202**	**Title of the Course**	**DC Machines and Transformer**	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**2**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To impart knowledge of d.c. machines and transformers used in homes, offices and industries • Student are ready for competitive exams • Students can handle the real time problems						

Course Outcomes	
CO1	**Identify ,Analyze** magnetic circuit of rotating machines(AC and DC) and to gain **knowledge** of EMEC system and to **develop** the dynamic model of EMEC system and **evaluate** the stored field energy ,force and torque in EMEC system
CO2	**Develop** the winding diagram of DC machines and **identify**, **evaluate** the generated e.m.f in dc generators and also **evaluate** the torque in dc motors and **analyze** the effects of armature reaction and commutation and gain **knowledge** of magnetization, internal and external characteristics of dc generators.
CO3	**Identify and Analyze** the DC machines performance and to gain **knowledge** of operating and performance characteristics of dc motors and **evaluate** the efficiency and speed of motors under different loading conditions also gain **knowledge** of dc motor starters and **identify** special motors
CO4	Gain **Knowledge** of two winding transformers and **analyze** the performance of single phase transformer and **develop** the equivalent circuit of transformer for **evaluating** the transformer electrical parameters
CO5	**Identify** and Gain **Knowledge** of single winding and multi winding transformer and **analyze** the phase groupings of three phase transformers and **evaluate** the electrical parameters of three phase transformers with similar or different vector group.

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Principle of EMEC**	**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-I**	**DC Generators**:Construction,function of commutator,simplex lap and wave windings, emf equation , armature reaction and commutation, remedial measures used for reducing commutation, D.C. generator characteristics	8	CO2
3	**DC Machines-II**	**DC Motors**: Torque equation, 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, PMDC machines, hysteresis motor, reluctance motor and stepper motor	8	CO3
4	**Electrical Transformer -I**	Principle of transformer action, construction of two winding transformer, equivalent circuit and phasor diagrams of ideal and real transformers, losses in transformers, per unit system **Testing of transformers**: Open circuit test, Short circuit test and Sumpner's test , 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 ,applications of different types of transformer	8	CO5

PRACTICAL

S. No.	List of Experiments	Contact Hrs.	Mapped CO
1	To study three point starter and four point starter.	2	1
2	Open Circuit Characteristic of DC Shunt Generator.	2	4
3	Study of Three Phase Transformer.	2	3
4	Armature and Field control of a compound motor	2	2
5	Speed Control of a DC shunt motor by armature and field control.	2	2
6	To obtain load Characteristic of DC Series Generator.	2	4
7	Polarity test of Single Phase Transformer	2	3
8	B-H curve of transformer	2	1
9	Parallel operation of D.C Generators.	2	4
10	Study of three phase transformer connections	2	3

Text Books:

1. Electric Machines ,Kothari &Nagrath, Mc Graw Hill, 5th Edition,2017
2. Electric Machines ,Mallick, M.A.& Ashraf ,I, IK International, 1st Edition,2009

Reference Books:

1. Electrical Machinery, Fitzgerald, Kingsley (McGraw Hill),6th Edition,2020
2. Electrical Machines and their Applications, J Hind Marsh,4th Edition,1984

e-Leaning Resources
https://archive.nptel.ac.in/courses/108/106/108106071/
https://nptel.ac.in/courses/108102146

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE203**	**Title of the Course**	**Analog and Digital Electronics**	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**2**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To understand the concepts of various types of amplifier circuits. • To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems. • To understand the concepts of combinational logic circuits. • To learn the analysis of various sequential circuits.						

Course Outcomes	
CO1	Student will be able to illustrate working principle of different Analog electronics circuits and their application
CO2	Understand the fundamental concepts and techniques used in operational amplifier and its applications
CO3	Students will be able to use the concepts of Boolean Algebra for the analysis & design of various combinational & sequential logic circuits.
CO4	For a given Combinational circuit, student shall be able to understand its various building blocks and examine, analyze and evaluate various gates and circuits
CO5	Given concept of sequential logic would be able to select suitable design of various flip flops, shift registers, counters and PLDs

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction**	Concept of basic circuits like amplifier, oscillator, linear power supply, power amplifiers, Basic electronics circuits as base for power electronics circuits like rectifier, inverter, power supply.	8	1
2	**Operational Amplifiers**	Differential amplifier, internal structure of an operational amplifier, Inverting and non-inverting amplifier, integrator, active filters, Current source, Wein bridge and phase shift oscillators	8	2
3	**Logic Families**	Introduction to different logic families, DTL, TTL, MOS. TTL inverter – circuit description and operation, CMOS inverter – circuit description and operation, design of gates using TTL and CMOS circuits, Electrical characteristics of logic gates	8	1
4	**Combinational logic circuits**	Simplification of logic functions using K-map, Adders, Subtractors, BCD arithmetic, carry look ahead adder, Multiplexer, De-Multiplexer, Encoders, Decoders, comparators, Parity generators/checkers	8	3,4
5	**Sequential circuits and systems**	Latches, SR, J- K, T and D types flip-flops, shift registers, asynchronous counters, synchronous counters, ring counter, Johnson counter, sequence generator, Multivibrators, PLDs	8	5

PRACTICAL

S.No.	List of Experiments	Contact Hrs.	Mapped CO
1	Study of Clipping and Clamping circuits	2	1
2	Study of single stage RC coupled transistor amplifier.	2	1
3	Application of operational amplifier as Inverting, Non-Inverting and unity gain amplifier	2	2
4	Study of V-I characteristics of N-MOS and P-MOS .	2	3
5	Realization of OR, NOR, XOR, XNOR gates using NAND gates and verify its truth table.	2	3,4
6	Design and study of Half Adder and Full adder	2	4
7	Design and study of 1-bit Magnitude Comparator	2	4

8	Design and test (a)J-K Flip Flop using NAND gates (b) D and T Flip Flop using IC 7476 and IC 7404	2	5
9	Design MOD-16 counter using Master -slave FF (IC 7476) and logic gates. Verify it's with truth table.	2	5
10	Design of Serial in Parallel Out [SIPO] Shift Registers using IC7476	2	5

Reference Books:

1.A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 4th edition, 2016.

2.Ramakant A Gayakwad, Op- Amps and Linear Integrated Circuits, Prentice Hall of India, 4th edition, 2012.

3.P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 5th edition, 2001.

4. Jacob Millman and Herbett Taub, "Pulse, Digital & Switching wave forms" Mc- Graw- Hill Education India, 4[3rd] edition, 2017.

5.Mano M Morris, "Digital Design" Person Education India, 6th edition, 2018.

e-Learning Source:

https://onlinecourses.nptel.ac.in/noc21_ee75/preview

https://archive.nptel.ac.in/courses/108/105/108105158/

https://youtu.be/X7M3rUxUpOc

https://onlinecourses.nptel.ac.in/noc22_ee55/preview

https://youtu.be/oNh6V91zdPY

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO &PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	1		1			1		2	3	2	
CO2	3	3	3	1		1	1		1		1	3		1
CO3	3	2	3	2	1	1			2		2	3		1
CO4	3	3	2	2	1				1		2	3	2	
CO5	3	3	2	1			1		1		2	3		1

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

Integral University, Lucknow

Effective from Session:2025-26							
Course Code	**EE204**	**Title of the Course**	**Measurement & Instrumentation**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	3	0	2	4
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	To provide knowledge of the measurement system, measurement methods and errors, measurement of electrical quantities To provide knowledge of the three phase power measurement; working of thermocouple, electrostatic and rectifier type instruments; energy meter and instrument transformer To provide knowledge of the measurement of low, medium and high resistances, use of ac bridges and Q meter To provide knowledge of the use of ac potentiometer; measurement of speed, frequency and power factor To provide knowledge of the digital measurement of electrical quantities; CRO and its application						

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

THEORY

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Philosophy of measurement**:	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	**Power measurement**	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	**Measurement of parameter**	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	**AC Potentiometer**	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	**Digital measurement**	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

PRACTICAL

Exp. No.	**Title of the Experiment**	**Content of Experiment**	**Contact Hrs.**	**Mapped CO**
1	Kelvin's Double Bridge	Measurement of Low Resistance by Kelvin's Double Bridge	2	1
2	Maxwell's Bridge	Measurement of Self- Inductance by Maxwell's Bridge	2	2

3	Hay's Bridge	Measurement of Self-Inductance by Hay's Bridge	2	2
4	Schering's Bridge	Measurement of Capacitance by Schering's Bridge	2	2
5	De Sauty's Bridge	Measurement of Capacitance by De Sauty's Bridge	2	2
6	Wein's bridge	Measurement of Frequency by Wein's Bridge	2	2
7	Voltmeter	Calibration of Voltmeter	2	3
8	Ammeter	Calibration of Ammeter	2	4

Reference Books:

1. E.W. Golding & F.C. Widdis, " Electrical measurement & Measuring" , A.W. Wheeler & Co. Pvt. L.td. India.
2. A.K. Sawhney, "Electrical & Electronics Measurement & Instrument", Dhanpat Rai & Son, 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: https://nptel.ac.in/courses/108105153

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE205**	**Title of the Course**	**Fundamentals of EMFT**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**III**	3	0	0	3
Prerequisite	None	**Co-requisite**	None				
Course Objectives	To develop a conceptual basis of electrostatics, magnetostatics, electromagnetic waves. To understand the students about coordinate systems and develop the ability to analyse three-dimensional space and obtain the solution of electromagnetic problems by Vector theorems and Operators. To analyze electrostatics problems by applying fundamental law's. To realize and examine the magnetostatics problems and response by applying fundamental law's. To recognize the concepts of Gauss Law and Maxwell equations by investigation in the real time domain . To learn the Concepts of Displacement Current, Wave Propagation and basics of transmission lines.						

Course Outcomes	
CO1	Solve mathematical problems in Cartesian, cylindrical, and spherical coordinate systems using vector theorems.
CO2	Describe static electric and magnetic fields, their behavior in different media, associated laws, boundary conditions and energy density
CO3	Apply the integral and point form of Maxwell's equations for solving the problems of electromagnetic field theory.
CO4	Analyze time-varying fields, propagation of electromagnetic waves in different media, Poynting theorem and their sources
CO5	For a given Transmission line, the students shall be able to define its parameters and have ideas about guided waves.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Co-ordinate System and vector theorems**	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.	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.	8	CO2, CO3
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	CO2, CO3
4	**Time-varying fields and 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, Poynting theorem and power flow, Reflection of plane wave at Normal Incidence.	8	CO3, CO4
5	**Transmission line and Guided waves**	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. Introduction to guided waves.	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:

https://archive.nptel.ac.in/courses/108/104/108104087/

https://www.udemy.com/course/electromagnetic-field-theory-transmission-lines/?srsltid=AfmBOorM9Z2RZxg-g6pDNjQx3_fSueoCyNskaUb48sPfhucfwaydJnUd&couponCode=ST22MT240325G3

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

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

Integral University, Lucknow

Effective from Session: 2025-26 (NEP)							
Course Code	CS203	**Title of the Course**	Cyber Law and Information Security	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	2	0	0	3
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	• Knowledge about cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft. • Knowledge on the disciplines of technology, E-business and law to allow them to minimize the occurrence and severity of information security incidents. • Knowledge about Information System and principles of Information Security (as confidentiality, integrity, and availability). • Knowledge of cryptography and techniques used to detect and prevent network intrusions.						

Course Outcomes	
CO1	Understand key terms and concepts in cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft.
CO2	Apply and analyze knowledge of technology, E-business, and law to minimize the occurrence and impact of information security incidents.
CO3	Understand and evaluate the principles of Information Security, including confidentiality, integrity, and availability, in relation to information systems.
CO4	Understand and apply cryptographic techniques and methods to detect and prevent network intrusions, ensuring secure data transmission.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Fundamentals of Cyber Law**	Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Unicitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, CopyRight, Trademark law, Law related to semiconductor layout & design.	8	CO1
2	**E - Commerce**	Security Threats to E - Commerce, Virtual Organization, Business Transactions on Web, EGovernance and EDI, Concepts in Electronics payment systems, E-Cash, Credit/Debit Cards, E- Agreement, Legal recognition of electronic and digital records, E- Commerce Issues of privacy, Wireless Computing- Security challenges in Mobile devices. Digital Signatures - Technical issues, legal issues, Electronic Records, Digital Contracts, and Requirements of Digital Signature System.	7	CO2
3	**Investigation and Ethics**	Cyber Crime, Cyber jurisdiction, Cyber crime and evidence act, Treatment of different countries of cyber crime, Ethical issues in data and software privacy, Plagiarism, Pornography, Tampering computer documents, Data privacy and protection, Domain Name System, Software piracy, Issues in ethical hacking. Internet security threats: Hacking, Cracking, Sneaking, Viruses, Trojan horse, Malicious Code & logic bombs. Introduction to biometric security and its challenges, Finger prints, Cyber crime forensic: CASE STUDY in Cyber Crime.	9	CO3
4	**Information security**	Information Systems and its Importance, Role of Security in Internet and Web Services, Principles of Information Security, Classification of Threats and attacks, Security Challenges, Security Implication for organizations, Security services - Authentication, Confidentiality, Integrity, Availability and other terms in Information Security, Information Classification and their Roles. Introduction to Cryptography, Issues in Documents Security, Keys: Public Key, Private Key, Firewalls, Basic Concepts of Network Security, Perimeters of Network protection & Network attack, Need of Intrusion Monitoring and Detection.	9	CO4

Reference Books:

Harish Chander "Cyber Law and IT Protection" , PHI Publication, New Delhi

Merkov, Breithaupt," Information Security", Pearson Education

"Cyber Law in India" - Farooq Ahmad-Pioneer books.

K. K. Singh, Akansha Singh "Information Security and Cyber law", Umesh Publication, Delhi

e-Learning Source:

https://nptel.ac.in/courses/106106248

https://onlinecourses.swayam2.ac.in/cec24_cs14/preview

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

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

Integral University, Lucknow
Attributes &SDGs Common for all branches/Disciplines
B.Tech. (All Branches)

Effective from Session:							
Course Code	**ES203**	**Title of the Course**	**Disaster Management and Mitigation**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	2	1	**0**	**3**
Pre-Requisite	NIL	**Co-requisite**	NIL				
Course Objectives	1. **Understand** the various types of disasters and **analyze** their profiles in the Indian context. 2. **Explain** the causes and **evaluate** the impacts of different disasters through case studies of national and global events. 3. **Apply** risk reduction approaches in disaster management and **analyze** safety measures for mitigating industrial disasters. 4. **Comprehend** the fundamental concepts of the Disaster Management Cycle and **implement** appropriate risk reduction strategies. 5. **Examine** national disaster mitigation acts and policies, and **assess** the roles of key stakeholders such as the Army, Police, Community, Corporate sector, and Media in post-disaster management from both national and global perspectives.						

Course Outcomes	
CO1	Students will be able to learn types of disasters and its profile in India
CO2	Students will be able to understand the causes and impacts of disasters on environment
CO3	Students will be able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters.
CO4	To understand the concept of Disaster Management Cycle and its Risk Reduction
CO5	Students will be able to learn the role of Acts, Policies, National and International Organizations in Disaster Management

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to disaster	Introduction to Disasters, Concepts, Definition and types (Natural and Man-made), Disaster profile of India.	6	CO1
2	Impact of Disaster	Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem., Case studies from Disasters, Large Hydro projects and its risks for Disasters.	8	CO2
3	Disaster Risk Reduction	Approaches to Disaster risk Reduction, Risk Assessments and Vulnerability Analysis Techniques, Safety issues in mitigating, Case studies, EHS	7	CO 3
4	Disaster Management	Disaster Management Cycle. Reconstruction and Rehabilitation. Early warning Systems Pre-Disaster Management, Post Disaster Management	6	CO4
5	Disaster Act and Policies	National Acts and policies for mitigating Disasters (Disaster Management Act 2005, NDRF, National Policy for Disaster Management 2009, Role of Army and Police Force in Disaster, Role of International/National Humanitarian aid/ Relief Organizations for Disaster management, Role of Community, Corporate, Media etc. for post Disaster Management.	9	CO5
6	Global Perspective (Natural and Manmade Disasters)	Case Studies of disasters induced by Human Activities and climate change such as earthquake, forest fire, flood, drought, landslides, Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	9	CO 5

Reference Books:

(1) Gupta Harsh K., Disaster Management, Hyderabad University Press, Publications-Meerut.
(2) Sethi, V.K., Disaster Management, New Delhi Maxford Books
(3) Bhattacharya, Tushar, Disaster Science and Management, New Delhi Tata Mc Graw Hill.
(4) Nidhi Gauba, Dhawan/ Ambrina Sardar Khan, Disaster Management and Preparedness, CBS

e-Learning Source:

https://www.youtube.com/watch?v=9WIwlljva_s

https://www.youtube.com/watch?v=uA_OLKfQpYA

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	2	1	1	1	1	2	3	-	2	2	1	2	1	2	-	-	-	-
CO2	2	2	2	1	2	2	3	-	2	2	2	2	1	2	-	-	-	-
CO3	3	2	2	1	2	2	3	-	2	2	1	2	1	2	-	-	-	-
CO4	2	2	3	1	2	2	3	-	2	1	1	2	1	2	-	-	-	-
CO5	1	1	2	2	1	1	2	-	2	2	1	2	1	2	-	-	-	-

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE215**	**Title of the Course**	**Electrical Simulation Lab**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**0**	**0**	**2**	**1**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Understanding Simulation Techniques: Students should grasp the fundamental concepts of simulation techniques used in electrical engineering. • Hands-on MATLAB Skills: Develop proficiency in using MATLAB for electrical simulations, including understanding the MATLAB environment, using built-in functions, creating scripts, and utilizing MATLAB's graphical capabilities. • Circuit Analysis and Design: Apply circuit analysis principles to solve complex electrical circuits involving resistors, capacitors, inductors, and operational amplifiers. Understand circuit behaviors, transient and steady-state responses, and frequency domain analysis. .						

Course Outcomes	
CO1	Adopt, perform, analyze and implement the methods of simulation techniques used in electrical engineering.by MATLAB.
CO2	Adopt, perform, analyze and implement the methods and develop proficiency in using MATLAB for electrical simulations, including understanding the MATLAB environment, using built-in functions, creating scripts byMATLAB
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, and plot of electrical circuits by MATLAB;contribute in related development

Exp. No.	Content of Experiment	Contact Hrs.	Mapped CO
1	To Study the elements, Components & blocks used in MATLAB/Simulink.	2	1
2	To realize an active circuit using MATLAB Simulink and obtain current and voltage at each branches.	2	1
3	To realize a half wave rectifier circuit using MATLAB/Simulink.	2	1
4	To realize a full wave rectifier circuit using MATLAB/Simulink.	2	2
5	To verify Thevenin's theorem using MATLAB/Simulink.	2	2,4
6	To verify Norton's theorem using MATLAB/Simulink.	2	2,4
7	To verify Maximum power transfer theorem using MATLAB/Simulink.	2	3
8	To verify Superposition theorem using MATLAB/Simulink.	2	3
9	To study frequency response of series RLC circuit using MATLAB/Simulink.	2	4
10	Development and simulation of program using MATLAB/Simulink.	2	2,3

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:

chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.asti.edu.in/images/pdf/departments/eee-downloads/academic-manuals/lab-manual/ecsl/electrical-circuit%20-simulation-lab.pdf

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

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

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

Integral University, Lucknow

Effective from Session: 2025-2026							
Course Code	BM226	**Title of the Course**	Human Values & Professional Ethics	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	IV	**3**	**0**	**0**	**0**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To help students understand the importance of human values and ethics in professional and personal life. • To develop a sense of social and environmental responsibility. • To enhance decision-making capabilities based on moral values and professional ethics. • To create awareness about the ethical responsibilities of engineers towards society. • To equip students with tools to handle ethical dilemmas in the workplace effectively.						

Course Outcomes	
CO1	Develop an understanding of human values, morals, and ethics for professional and personal growth.
CO2	Analyze and apply ethical reasoning in decision-making for professional and social well-being.
CO3	Demonstrate awareness of environmental, social, and sustainability responsibilities in engineering practices.
CO4	Identify ethical dilemmas and implement professional ethics in engineering projects.
CO5	Develop skills for effective communication, teamwork, and leadership while adhering to ethical values.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction to Human Values	Definition, Types of Values, Morals, Ethics, and Character, Need for Ethics in Engineering. Value Education, Self-Exploration. Natural Acceptance and Experiential Validation, Continuous Happiness and Prosperity, Right understanding, Understanding Happiness and Prosperity correctly.	6	CO1
2	Introduction to Ethical Concept	Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law.	6	CO2
3	Corporate Social Responsibility & Sustainability	The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Role of Engineers in Society, Ethical Theories, Decision Making Frameworks, Conflicts of Interest Environmental and Social Responsibilities, Sustainability, Safety, and Risk Assessment	6	CO3
4	Ethical Dilemmas and Case Studies	Senses of 'Engineering Ethics', variety of moral issues, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Valuing Time, Case Studies on Professional Ethics, Corporate Misconduct, Whistleblowing	6	CO4
5	Communication and A Glimpse of Life Stories on Leadership with Ethics	Effective Communication, Teamwork, Leadership, and Ethical Conduct. Environmental ethics, computer ethics, weapons development, engineers as managers consulting engineers, engineers as expert witnesses and advisors, moral leadership. Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs.	6	CO5

Reference Books:

- R. R. Gaur, R. Sangal, G. P. Bagaria, "A Foundation Course in Human Values and Professional Ethics," Excel Books, 2010.
- Govindarajan M., Natarajan S., Senthil Kumar V. S., "Engineering Ethics (Includes Human Values)," PHI Learning, 2013.
- Charles D. Fleddermann, "Engineering Ethics," Pearson Education, 4th Edition, 2012.
- Mike W. Martin, Roland Schinzinger, "Ethics in Engineering," McGraw Hill, 4th Edition, 2013.
- R.S. Naagarazan, "Professional Ethics and Human Values," New Age International, 2006.

e-Learning Source:

https://www.youtube.com/watch?v=XiN8iqJGb48&list=PLFW6lRTa1g83uYgRiZEy_F4pzedPNWpew

https://www.youtube.com/watch?v=vS31O3XfH_0&list=PLyVhmjhvTvDYR2K4FgFYuK2gfUibZG8YA

https://www.youtube.com/watch?v=8gpzLafYPcA

https://www.youtube.com/watch?v=xXyatU-l07w

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE211**	**Title of the Course**	**CONTROL SYSTEM**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**3**	**0**	**2**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To learn the concept of transfer function and mathematical modeling of systems. • To evaluate the transient and steady-state responses of first and second-order systems and analyze system performance using time-domain criteria and performance indices. • To determine system stability using Routh-Hurwitz criteria and asymptotic stability conditions and analyze frequency response characteristics and establish time-frequency domain correlations. • To construct and interpret root locus plots and Nyquist plots for stability analysis and evaluate system stability using gain margin, phase margin, and frequency response parameters. • To design compensators and develop control systems using root locus and Bode plot techniques. Introduce state-space representation.						

Course Outcomes	
CO1	Understand the fundamentals of control systems and their mathematical modeling
CO2	Analyze System Response in the Time Domain
CO3	Determine System Stability and Frequency Response
CO4	Perform Root Locus and Nyquist Analysis
CO5	Design and Implement Control Strategies

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Fundamentals of control system**	Introduction to control system, Open and closed loop control system, Mathematical modeling of physical systems, Transfer function of electrical and mechanical system, Analogous systems, Block Diagram Reduction Algebra and signal flow graph, Mason's gain formula.	8	CO1
2	**Time Domain Analysis**	Time domain criteria; Test Signals; Transient and steady state response of first and second order feedback systems; Performance indices; Response analysis with proportional, Proportional- Derivative (PD) controller, Proportional-Integral (PI) controller and Proportional- Integral –Derivative (PID) controller.	8	CO2
3	**Stability Analysis**	Asymptotic and conditional stability, Routh Hurwitz criterion, Frequency response analysis, Correlation between time and frequency domain specifications, Resonant peak, Resonant frequency, Bandwidth, Cutoff frequency, Polar plots, Bode plots.	8	CO3
4	**Root Locus & Stability**	The root locus concepts, Construction of root loci, Nyquist stability criterion, Relative stability, Gain margin, Phase margin, Constant M and N circles.	8	CO4
5	**Design of control system and Introduction to State space**	Design through compensation Techniques; Realization of Lag, Lead, And Lag-Lead compensation; Design of closed loop control system using root locus and bode plot compensation. Introduction to State variable analysis, State space representation, State equations, State transfer matrices, Controllability and observability.	8	CO5

PRACTICAL

S.No	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1.	To study the performance characteristics of a DC motor speed control system. 1) Open loop 2) Close loop	2	1
2.	To study the steady state behavior of type 0 system.	2	2
3.	To study the phase lag network.	2	4
4.	To study the performance of various types of controllers used to control the temperature of an oven. • ON /OFF control • Proportional control	2	4
5.	To study the Transient response of a series RLC circuit.	2	2
6.	To study and plot speed vs voltage characteristic of the dc servo motor	2	1
7.	To plot root-locus and Nyquist plot using MATLAB/ SIMULINK.	2	3
8.	To design controller using root-locus in MATLAB/ SIMULINK.	2	5

Reference Books:
1 .B. C. Kuo, “Automatic Control system”, Wiley, 9th Edition, 2014.
2. I. J. Nagrath & M. Gopal, “Control system Engineering”, New Age International, 4th Edition, 2015.
3. K. Ogata, “Modern Control Engg.”, PHI, 4th Edition, 2002.
4. S. K. Bhattacharya, “Control system Engg.”, Pearson Education, 2nd Edition, 2008.
5. S. Hasan Saeed, “Automatic control system”, Kataria and sons, New Delhi, 8th Edition, 2016
e-Learning Source:
https://archive.nptel.ac.in/courses/107/106/107106081/

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE 212**	**Title of the Course**	**AC and Special Electrical Machines**	L	T	P	**C**
Year	**II**	**Semester**	**IV**	**3**	**0**	**2**	**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

THEORY

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Three phase Induction Machine I**	Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications.	8	CO1
2	**Single phase Induction Motor**	Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motor. AC Commutator Motors: Universal motor, single phase a.c.series compensated motor.	8	CO2
3	**Synchronous Machine I**	Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and Phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co- efficient .	8	CO3
4	**Synchronous Machine II**	Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics. Synchronous Motor: Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser.	8	CO4
5	**Special Machine**	Deep bar and double cage rotors, BLDC Motor, Stepper Motor	8	CO5

PRACTICAL

S.No	**List of Experiments**	**Contact Hrs**	**Mappped CO**
1.	To study (1) DoL starter, (2) Star/Delta starter.	2	3
2.	To study speed control of three phase squirrel cage induction motor by frequency variation.	2	4

3.	To perform no load & block rotor test on a single phase motor.	2	3
4.	To study single phase capacitor start induction motor and observe (a) effect of capacitor on starting & running of (b) reversal of direction of induction motor.	2	2
5.	To study of synchronization of an alternator by dark lamp method.	2	3
6.	To study of synchronization of an alternator by two bright & one dark lamp method.	2	2
7.	To determine voltage regulation of 3 phase alternator by capacitive & inductive loading.	2	3
8.	To study speed control of 3 phase squirrel cage induction motor voltage variation method.	2	3
9.	To plot N/T characteristic of 3 phase squirrel cage induction motor.	2	2
10.	To plot V-curve and inverted V- curve of synchronous motor.	2	4
11.	To draw open circuit characteristic & short circuit characteristic of 3 phase alternator.	2	4

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

e-Learning Source:

https://youtube.com/playlist?list=PLqIYaMBZyiJMewdsRRTLWx2BGkYQ286K0&si=YQewhVeKrgv1-Wj2

https://www.youtube.com/live/M9YxXAANk4s?si=iadu0hd7V8Y8Qd5N

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1							3	3	2	1
CO2	3	2	3	1							2	3	2	2
CO3	3	1	1	1							3	2	2	1
CO4	3	2	2	2							2	3	3	1
CO5	3	2	1	1			1				2	3	1	2

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

Integral University, Lucknow

Effective from Session:2025-26 (NEP)							
Course Code	CS204	**Title of the Course**	Data Structure Using C	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	3	0	2	4
Pre-Requisite	-	**Co-requisite**	-				
Course Objectives	• To comprehend the basics of Data Structure, their Managements and Operations such as array, string manipulations and various operations over different kinds of linked lists. • To learn stack & queue data structure and various applications based on the phenomenon of recursion, polish notations and polish conversions, priority Queue & its Programming implementation. • Understanding the tree data structure and its various types & applications to develop the efficient solutions and fine tune the complexity of solutions through its Programming implementation. • To study the various sorting and searching techniques and various algorithmic approaches, know hashing and collision resolving techniques & its Programming implementation. • To Understand and implement the hierarchical data structure such as Graph and its various traversal algorithms, concept of file organization and record handling						

Course Outcomes	
CO1	Recall and understand the basics of data structures, their programming implementations, and foundational concepts for developing better solutions using Array and Linked list.
CO2	Apply, analyze, and evaluate stack and queue data structures, understand the phenomenon of recursion, and implement various applications based on these principles.
CO3	Develop and assess solutions using tree data structures, applying recursive approaches to enhance the efficacy of the solution to the complex problems.
CO4	Apply, analyze, and evaluate different searching and sorting algorithms, assessing their performance to ensure optimized data handling.
CO5	Understand, create, and, implement solutions for graph based data structures & file organization techniques to develop efficient solutions using non-linear data structure approaches.

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Introduction to Data Structures**	**Basic Terminology:** Elementary Data Organization, Data Structure Operations. Algorithms, Analysis of Algorithms, Complexity of Algorithms, Time-Space Tradeoff. **Arrays:** Array Definition, Representation and Analysis, Single and Multi-Dimensional Arrays, Address Calculation, Application of Arrays, Character String Representation, Character String Operation, Sparse Matrices & Vectors. **Linked List:** Representation and Implementation of Singly Linked List, Traversing, Searching of Linked List, Insertion & Deletion to/from Linked List, Underflow & Overflow. Circular Linked List, Doubly Linked List, Two- way Header List, Polynomial Representation & Addition, Generalized Linked List, Garbage Collection and Compaction	9	1
2	**Stacks & Ques**	**Stack**: Array Representation and Implementation of Stack, Operations on Stacks: Push & Pop, Linked Representation of Stack, Application of Stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of Postfix Expression using Stack. Recursion: Recursive Definition and Processes, Recursion in C, Example of Recursion, Tower of Hanoi Problem. **Queues:** Array and Linked Representation and Implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty; Circular Queues, D-queues and Priority Queues**.**	9	2
3	**Trees**	Basic Terminology, Binary Trees, Binary Tree Representation, Algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary Trees, Traversing Binary Trees, Threaded Binary Trees, Traversing Threaded Binary Trees, Huffman Algorithm, Binary Search Tree (BST), Insertion and Deletion in BST, Path Length, AVL Trees, B-trees.	8	3
4	**Searching, Sorting and Hashing**	Sequential Search, Binary Search, Comparison and Analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation. **Sorting:** Insertion Sort, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort.	7	4
5	**Graphs**	**Graph:** Terminology & Representations, Graphs & Multi-Graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees. **File Handling:** Physical Storage Media File Organization, Organization of Records into Blocks, Sequential Files, Indexing and Hashing, Primary Indices, Secondary Indices	7	5

PRACTICAL			
S.No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	To implement Array: Insertion, deletion and Pattern matching of a substring in an Arrays & searching an element in an Array using Iterative Binary Search	2	1
2	To implement Linked Lists: Creation, insertion deletion and searching in a singly linked list as well as in a doubly linked list.	2	1
3	To Implement Stack (using Array approach as well as Linked approach): Push & Pop operations, converting infix	2	2
	expression to its postfix form, and, Tower of Hanoi using Recursion.		
4	To Implement QUEUES (using Array approach as well as Linked approach): Insertion & Deletion in a Linear Queue, DQueue and Circular Queue.	2	2
5	To Implement Tree: Creation, Insertion, Deletion of nodes in a tree and Tree Traversal algorithms using Recursive and Non-Recursive approach.	2	3
6	To implement an AVL Tree.	2	3
7	To Implement Searching: Linear Search, Binary Search, and Hashing.	2	4
8	To Implement Sorting: Insertion Sort, Quick Sort, Merge Sort, Bubble Sort and Heap Sort.	2	4
9	To Implement Graph: Creation of Graph, Searching in Graph.	2	5
10	To Implement various Graph traversal algorithms.	2	5

Reference Books:

1. M. Tannenbaum. "Data Structure Using C/C+"
2. Horowitz And Sahani "Fundamental of Data Structure", Galgotia Publication
3. A Lipschutz "Data Structure", Schaum series.
4. Reema Thareja, "Data Structure Using C", Oxford University Press

e-Learning Source:

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https://archive.nptel.ac.in/courses/106/105/106105085/

https://onlinecourses.swayam2.ac.in/cec24_cs17/preview

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1						1	2	1
CO2	3	3	2	2	2	1						3	3	1
CO3	3	3	3	2	2	1						3	3	2
CO4	3	3	3	2	3	2						3	3	2
CO5	3	3	3	3	3	2						3	3	2

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE 213**	**Title of the Course**	**Elements of Power System**	**L**	**T**	**P**	**C**
Year	II	**Semester**	III	**3**	**0**	**2**	**4**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To get knowledge of Power System Components and Transmission Lines • To get knowledge of inductance and capacitance of Over-Head Transmission Lines • To attain knowledge of Corona and Overhead line Insulators • To study about Mechanical Design of transmission line and Insulated cables • To have the knowledge of Electrical Design of Transmission Line and Neutral grounding						

Course Outcomes	
CO1	Understand the Power System Components and Transmission Lines
CO2	Analyse the inductance and capacitance of Over-Head Transmission Lines
CO3	Understand the phenomenon of Corona and Overhead line Insulators
CO4	Having knowledge of Mechanical Design of transmission line and Insulated cables
CO5	Design Electrical Transmission Line and Neutral grounding

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Power System Components and Transmission Lines**	Single line Diagram of Power system, Brief description of Power System Elements: Synchronous machine, transformer, transmission line, busbar, circuit breaker and isolator. Different kinds of supply system and their comparison, Choice of transmission voltage. Transmission Line Configurations, Types of conductors, Resistance of line, Skin effect, Kelvin's law, Proximity effect.	8	CO1
2	**Over Head Transmission Lines**	Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines; Representation and performance of short, medium and long transmission lines; Ferranti effect; Surge impedance loading.	8	CO2
3	**Corona and Overhead line Insulators**	Phenomenon of corona, Corona formation, Calculation of potential gradient, Corona loss, Factors affecting corona, Methods of reducing corona and interference, Electrostatic and electromagnetic interference with communication lines. Types of insulators and their applications, Potential distribution over a string of insulators, Methods of equalizing the potential, String efficiency.	8	CO3
4	**Mechanical Design of transmission line and Insulated cables**	Centenary curve, Calculation of sag & tension, Effects of wind and ice loading, Sag template. Type of cables and their construction, Dielectric stress, Grading of cables, Insulation resistance, Capacitance of single phase and three phase cables, Dielectric loss, Heating of Cables	8	CO4
5	**Electrical Design of Transmission Line and Neutral grounding**	Design consideration of Extra High Voltage (EHV) transmission lines, Choice of voltage, Number of circuits, Conductor configuration, Insulation design and selection of ground wires. Necessity of neutral grounding, Various methods of neutral grounding, Earthing transformer,Grounding practices.	8	CO5

PRACTICAL

S. No.	**List of Experiments**	**Contact Hrs.**	**Mapped CO**
1	To study accessories like MCB, Contactor, Cable, Switches, Changeover, insulator etc used in Power System. (Part A)	2	1
2	To study accessories like Relays, contactor, single phase auto transformer etc used in Power System. (Part B)	2	1
3	To find out transformer oil breakdown voltage	2	1
4	Find out voltage distribution and string efficiency across the string of insulators with & without guard ring.	2	2,3

5	To calculate steady state power limit of Transmission Line in loaded condition.	2	2,3
6	To calculate ABCD Parameters of Transmission Line.	2	2,3
7	To maintain bus voltage and unity power factor under fixed capacitance condition.	2	1
8	(a)To measure direct- axis of synchronous reactance of synchronous machines. (Xd and Xq). (b) To measure quadrature axis subtransient reactance.	2	1
9	To measure negative sequence reactance and zero sequence reactance of synchronous machines.	2	1
10	(a) To measure direct-axis synchronous reactance of synchronous machine. (b) To measure quadrature axis synchronous reactance by slip test.	2	1

Reference Books:

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill, 4th revised edition,1982.
2. C. L. Wadhwa, "Electrical Power Systems", New age international Ltd , 6th Edition, 2010.
3. L.P. Singh, "Advance Power System Analysis & Dynamics", New Academic Science, 6th edition, 2012.
4. Ashfaq Hussain, "'Power System", CBS Publishers and Distributors, 5th Edition, 2010.

e-Learning Source: e-Learning Source: https://archive.nptel.ac.in/courses/108/105/108105104/

Course Articulation Matrix: (Mapping of COs with POs and PSOs) PO

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	3		1	2	1				3	2	2
CO2	3	3	2	3								3	2	2
CO3	3	3	2	3				1				3	3	2
CO4	3	2	3	2			3		3	2	1	2	3	2
CO5	3	2	3	2	2	2			3	2	1	2	3	2

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE214**	**Title of the Course**	**Signal and Systems**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	3	0	0	3
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 transform

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Formalizig 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:

NPTEL :: Electronics & Communication Engineering - Signals and Systems

Lecture Notes | Signals and Systems | Electrical Engineering and Computer Science

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE221**	**Title of the Course**	**Numerical Analysis**	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
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.

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Errors and Approximations**	**Error:** Error definitions, accuracy and precision, round off and truncation errors **Roots of equations:** Solution of Algebraic and Transcendental equations, Newton-Raphson method, Bisection method, Fixed Iteration method, Regula-Falsi method. **Finite differences:** Forward differences, Back ward differences	8	CO1
2	**Solutions of Simultaneous Linear Algebraic Equations**	**Linae algebraic equations:** Gauss elimination method, Gauss-Jordan method, L-U decomposition methods, **Iterative Method**: Gauss-Seidel, Jacobi's method.	8	CO2
3	**Curve Fitting and Interpolation**	**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:** 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 and Integration**	**Numerical differentiation:** Newton's Gregory forward interpolation formula to get derivatives, Newton's Gregory backward interpolation formula to get derivatives. **Numerical integration:** Newton-cotes quadrature formula, Trapezoidal rule, Simpson's rule.	8	CO4
5	**Numerical Solutions for Ordinary Differential Equations**	**Ordinary differential equations:** Initial and Boundary value problems, 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 Resources:

1. https://archive.nptel.ac.in/courses/111/101/111101165/
2. https://archive.nptel.ac.in/courses/111/107/111107105/
3. https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2012/

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

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

Integral University, Lucknow

Effective from Session : 2025-26							
Course Code	**EE222**	**Title of the Course**	**Illumination Engineering**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**3**	**0**	**0**	**3**
Pre-Requisite	**None**	**Co-requisite**	**None**				
Course Objective	• To understand the basics of illumination engineering • To understand the illumination system • To understand indoor lighting and indoor illumination design • To understand the outdoor lighting • To understand the modern trends in illumination						

Course Outcomes	
CO1	Understanding of Basics of Illumination Engineering
CO2	Understanding of Illumination Systems and its deign considerations
CO3	Understanding and implementation capability of indoor illumination design and scheme for residential, educational, medical and commercial Installations
CO4	Understanding and implementation capability of outdoor illumination design and scheme
CO5	Understanding and implementation capability of Modern trends in Illumination such as LED, Organic Lighting System, Laser and Optic Fiber

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Illumination Engineering Basics**	Introduction- Necessity of illumination, Physical processes employed in the artificial sources. Eye and Vision, Laws of illumination, Light: Production, physics of generation, Photometry: Properties, quantification and measurement, Glare, Effect of Glare, Glare Indices, Color rendering index	8	1
2	**Illumination Systems**	Luminaries: Types, Design considerations, Standard (IEC598), Lighting fixtures, Construction and working of various types of Lamps, Electrical control of light sources using Ballast	8	2
3	**Indoor Lighting**	Zonal cavity method for general lighting design, Determination for zonal cavities and different shaped ceilings using COU (Coefficient of Utilization), Beam angles and polar diagram, Factors to be considered for design of indoor illumination scheme. Indoor Illumination Design: Residential, Educational institute, Hospitals and commercial Installation.	8	3
4	**Outdoor Lighting**	Factors consideration on designing of outdoor illumination scheme, Sports lighting, Flood lighting, Road lighting, Lighting for advertisement/Holding, Lighting calculation, Lighting applications	8	4
5	**Modern Trends in Illumination**	LED Luminary designs, Intelligent LED fixtures, Natural lighting conductor, Organic lighting system, Laser characteristics, Features and applications, Optical fiber constructions light guide, Features and applications	8	5

Reference Books:

1. D.C. Pritchard Lighting, Routledge, 2018
2. H.Partab, "Art and Science of Electrical Energy" Dhanpat Rai & Sons, 2017
3. Craig Di Louie, "Advanced Lighting Controls: Energy Savings, Productivity, Technology and Applications", CRC Press, 2017
4. Kao Chen, "Energy Management in Illuminating Systems", Carlsons Consulting Engineers, San Diego, California, USA, CRC Press, 2009
5. Mark Stanley Rea, "IESNA Lighting Handbook", Illuminating Engineering Society of North America, 2000
6. S. M. Chaudhari, "Illumination Engineering", Tech Knowledge Publications, 2019

e-Learning Source:
https://archive.nptel.ac.in/courses/108/105/108105060/

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)													
PO- PSO **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	1	2	3	1		1	1	1		3	2	2
CO 2	3	3	1	2	3				2	1		3	2	
CO 3	3	2	1	1	3	2			2	1		3	1	3
CO 4	3	1	1	1	3				2	1		3	3	2
CO 5	3	2	1	3	3	1		2	2	1		3	2	1

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE223 (DE-I)**	**Title of the Course**	**Electrical Engineering Materials and Devices**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	3	0	0	3
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 the properties, processes, and industrial applications of diverse electrical engineering materials,						

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	Develop a comprehensive understanding of dielectric properties, insulation materials, and their applications, including polarization, dielectric loss, piezoelectricity, ferroelectricity, and the thermal effects on transformer oil,
CO3	To provide students with a moderate level understanding about the properties, structures, and materials of various semiconductor-based solar cells, including crystalline and amorphous silicon, and advanced solar technologies, such as CdTe thin films, organic cells, and dye-sensitized solar cells.
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	To understanding properties, applications, and processes of engineering materials, including thermocouples, superconductors, fluorescent materials, galvanizing, impregnation, and the Meissner effect in industrial applications."

THEORY

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, Thermo-couple materials-soldering materials, super alloys, Meissner effect, Introduction to superconductors, and its superconductors. .	8	CO1,
2	**Dielectrics, Insulating & 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, Effect of temperature on transformer oil	8	CO1,
3	**Photovoltaic Solar Energy Materials**	Types of semiconductor, single crystalline and polycrystalline silicon solar cells, amorphous silicon solar cells. Introduction to Thin film solar cells: CIGSl, and Cadmium Telluride thin film solar cells materials. Introduction to Organic cell	8	CO3
4	**Magnetic Materials & 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.	8	CO4,
5	**Fabrication and Characterization of Materials**	**Introduction to Planar process:** lithography, etching, spin coating, sputtering, CVD and PVD. Carbon nanotube, synthesis (CVD only), properties and applications. Material characterization techniques such as scanning electron microscopy, transmission electron microscopy.	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:

https://www.youtube.com/watch?v=Gg-WIZt4R_M&list=PL6oes2L0ajt0X9K4pJuWMOsxchvZTRYMP

https://www.youtube.com/watch?v=G41t_0CqPzY&list=PLbMVogVj5nJTqQc4Takon3QAhrtOLBV4M

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

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

Integral University, Lucknow

Effective from Session: 2025-26							
Course Code	**EE216**	**Title of the Course**	**Mini Project**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**0**	**0**	**4**	**2**
Pre-Requisite		**Co-requisite**					
Course Objectives	• Implementing a project independently by applying knowledge to practice • Literature review and well-documented report writing • Creating PPTs and effective technical presentation skills • Writing technical paper in scientific journal style & format						

Course Outcomes	
CO1	Apply knowledge to practice to design and conduct experiments and utilize modern tools for developing
CO2	Working models / process / system leading to innovation and entrepreneurship
CO3	Demonstrate the competencies to perform literature survey, identify gaps, analyze the problem
CO4	Prepare a well-documented Minor project report

Continuous Internal Evaluation (CIE) for Minor Project

1) The Minor Project Evaluation Committee shall be constituted with HoD as a Chairman, B. Tech. Coordinator as a Convener and three to five other faculty members representing various specializations in that particular programme as members.
2) Students have to take up minor project as a group of 3 on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study which would supplement and complement the program assigned to the students
3) The Committee shall allot a faculty supervisor to each student group for guiding on
(a) Selection of topic
(b) Literature survey and work to be carried out
(c) Preparing a report in proper format
(d) Right conduct of research and academic activity to promote academic integrity
(e) Use of anti-plagiarism software to detect plagiarism in the report and submission of Minor project report within acceptable plagiarism levels
(f) Effective minor project oral presentation before the committee
4) The CIE for mini project is as follows:

Assessment	**Weightage**
Minor project Supervisor Assessment	**20%**
Committee Assessment: **(i)** Registration presentation **(10%)** **(ii)** Working model / process / software package / system developed **(20%)** **(iii)** Minor project report **(20%)** **(iv)** Minor project paper **(10%)** **(v)** Final presentation (with PPT) and viva-voce **(20%)**	**80 %**
Total Weightage	**100%**

Note: It is mandatory for the student to
(i) appear for final presentation (with PPT) and viva-voce to qualify for course evaluation
(ii) write minor project paper in given journal format
(a) **Minor Project Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals/Technical Magazines on the topics of potential interest
(b) **Working Model**: Each student group is requested to develop a working model/ process/ software package /system on the chosen work and demonstrate before the Committee as per the dates specified by the Committee
(c) **Minor Project Report:** Each student is required to submit a well-documented mini project report as per the format specified by the Committee
(d) **Anti-Plagiarism Check:** The minor project report should clear plagiarism check as per the Anti- Plagiarism policy of the institute
(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the committee as per the schedule notified by the department

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

2-LowCorrelation;2-ModerateCorrelation;3-SubstantialCorrelation

Integral University, Lucknow

Effective from Session:2025-26							
Course Code	**EE251**	**Title of the Course**	**Energy Conservation, Energy Audit and Management**	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To identify and implement opportunities for reducing energy consumption and improving efficiency in systems, processes, and equipment, thereby lowering operational costs. • To minimize the environmental footprint by reducing greenhouse gas emissions, resource depletion, and pollution associated with excessive energy use. • To achieve financial savings through optimized energy usage, which helps businesses, industries, and households reduce energy bills and invest in sustainable practices. • To ensure adherence to national and international energy policies, standards, and environmental regulations, fostering sustainable energy practices and improving corporate social responsibility.						

Course Outcomes	
CO1	Students will gain a solid understanding of various energy systems, energy flow, and the factors influencing energy consumption in different industries, buildings, and transportation sectors.
CO2	Students will be able to effectively conduct energy audits, assess energy usage patterns, identify inefficiencies, and recommend practical solutions for energy optimization.
CO3	Students will acquire the skills to develop and implement energy management strategies, monitor energy performance, and use energy management tools to improve energy efficiency in organizations.
CO4	Students will be able to analyze environmental impacts of energy use, apply sustainable energy conservation measures, and ensure compliance with energy regulations and standards to support environmental responsibility.

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Energy Scenario**	Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance. Re-structuring of the energy supply sector, energy strategy for the future.	8	CO1
2	**Energy Management & Audit**	Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.	8	CO2
3	**Energy Action Planning**	Key elements, force field analysis, Energy policy purpose, perspective, contents, formulation, ratification, Organizing - location of energy management, top management support, managerial function, roles and responsibilities of energy manager, accountability.	8	CO3
4	**Energy Monitoring and Targeting**	Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of differences (CUSUM).	8	CO4

Reference Books:

1. Handschin, E. "Energy Management Systems", Springer Verlag, 1990.
2. John D Mc Donald, "Electric Power Substation Engineering", CRC press, 2001.
3. Wood, A. J and Wollenberg, B. F, "Power Generation Operation and Control", 2nd Edition John Wiley and Sons, 2003.
4. Green, J. N, Wilson, R, "Control and Automation of Electric Power Distribution Systems", Taylor and Francis, 2007
5. Turner, W. C, "Energy Management Handbook", 5th Edition, 2004.

e-Learning Resources:

1. https://onlinecourses.swayam2.ac.in/nou23_es05/preview
2. https://nptel.ac.in/courses/112105221

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

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

Integral University, Lucknow

Effective from Session:2025-26							
Course Code	**EE341**	**Title of the Course**	**Fundamental of Renewable Energy Systems**	**L**	**T**	**P**	**C**
Year	**II**	**Semester**	**IV**	**3**	**0**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	Basics of Electrical Engineering.				
Course Objectives	▪ To develop foundational knowledge to analyze, design, and apply Renewable Energy systems effectively in real-world to Reducing climate change ▪ To develop a technological understanding to harness the Renewable Energy system, to reduce reliance on fossil fuels for future energy security. ▪ Identify, Analyse Renewable Energy to achieve sustainable development by ensuring access to affordable, reliable, and modern energy.						

Course Outcomes	After the completion of this course, students will be able to:
CO1	To understand, Identify and define various renewable energy sources.
CO2	Analyse the basic principles of how each renewable energy source is converted into electricity or usable heat.
CO3	Analyze the advantages and limitations of solar energy technologies.
CO4	Explain the basic working principle of wind energy conversion system
CO5	Analyse and understand the important types of renewable energy sources; identify and describe their key components.

THEORY

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Renewable Energy Sources**	Energy Crisis, Conventional and Non-Conventional Energy, Solar Energy, Wind Energy, Geothermal energy, Biomass energy, Biofuel energy, Tidal energy.	8	CO1 , CO4
2	**Solar Radiation and Solar Cell.**	Principles of Solar Radiation, Solar Spectrum, Extra-terrestrial Radiation, Radiation on the Earth Surface, Global, Direct and Diffuse Solar Radiation, Solar Radiation at a Given Location, Annual Variation in Solar Radiation, Optimal Tilt for Solar Equipment.	8	CO2
3	**Fundamentals of Solar Cells**	Photovoltaic Cells. Solar cell hierarchy, Theory of p n junction, Principle of operation of p-n junction Solar Cell, Parameters of Solar Cells, Factors affecting Electricity generated from a Solar Cell I-V Characteristics Solar Cell parameters, Voc, Isc, FF, conversion efficiency and power output of solar cell. Introduction of MPPT. Limitation of solar Energy.	8	CO2, CO3
4	**Wind Energy**	Origin of Winds, Wind Turbine Siting, Wind turbine components, aerodynamics of wind turbine blades, wind power generation principles, Types Wind Turbine and its application. Wind Energy Conversion Systems (WECS). Wind Energy Program in India.	8	CO4, CO5,
5	**Biomass Energy. Geothermal & small hydro Energy.**	Biomass Resources, Biomass Conversion Technologies, Biogas Production from Waste Biomass, Biomass Gasification, Types of Geothermal Resources and conversion principle, Tidal Energy conversion principle, Hydro Resources, Small Hydro Plant and its Advantages and Disadvantages	8	CO5

Reference Books:

- Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI, Learning Publications, 3rd Edition, 2015.
- B.H.Khan, Non-Conventional Energy Resources" Tata Mc Graw-Hill Pvt. Ltd, Third Edison 2017.
- Roger A. Messenger and Jerry Ventre, 'Photovoltaic Systems Engineering', Taylor and Francis
- Group Publications, 3rd Edition, 2010(CRC Press Reprint – 2018)
- Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems, Academic Press,(Elsevier)2ndedition ,2014
- Web Reference: https://onlinecourses.nptel.ac.in/noc22_ee71/preview

e-Learning Source:

- http://nptel.iitm.ac.in.
- https://www.youtube.com/watch?v=yNiEJzFrqjE&list=PLmJzSa3IrL46RzXP2Ka0YUrH4vJ9UyRXM.

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

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

Integral University, Lucknow

Effective from Session:2025-26							
Course Code	**EE342**	**Title of the Course**	**Fundamentals of Power Electronics in EVs**	**L**	**T**	**P**	**C**
Year	II	**Semester**	IV	**3**	**0**	**0**	**3**
Pre-Requisite	None	**Co-requisite**	None				
Course Objectives	• To learn about the fundamentals of power electronics and their importance in EVs. • To know the concepts of DC-DC converters, inverters, and chargers used in EV systems. • To enable students about motor control techniques for smooth and efficient EV operation. • To aware students of Battery management systems (BMS) for optimal performance and longevity. • To learn about the maintenance and protection methods in modern electric vehicles.						

Course Outcomes	
CO1	Student will be able to understand the basics of electric vehicle history and the basics of power electronics, including power semiconductor devices, converters, and inverters
CO2	Student will be able to tell about power management and challenges in EVs.
CO3	Student will be able to understand the properties of batteries and charging.
CO4	Student will be able tTo understand the properties of electric vehicle drive systems.
CO5	Student will be able to describe about maintenance and protection needed for EVs.

THEORY

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	**Power Electronics in EVs**	**Introduction to Electric Vehicles:** Present scenario of electric vehicles, Need of Electric Vehicles, Types of electric vehicles (PEV, BEV, FCEV, HEV), Economic and environmental impacts of using Electrical vehicles. **Introduction to Power Electronics:** Significance and components of power electronics in EVs, Types of power converter (PWM inverter and Buck-Boost converter) and their role, Advanced & Future trends in power electronics for EVs.	8	CO1
2	**Power Management & Challenges in EVs**	Analogy and differences between ICE drive train and EV drive train, basic concept of voltage, current, power, energy in EVs, understanding power management system, Alternate energy sources (PV cell, fuel cell, supercapacitor, flywheel). Challenges faced by EV to replace ICE, Challenges of BEV, HEV, FCEV.	8	CO2
3	**Energy Storage and Charging System**	**Battery-based energy storage:** Overview of batteries, Battery Parameters, Battery pack with Battery Management System, Onboard charger. **EV charging system:** Types of chargers, components of EV chargers, Charging standards and connectors,	8	CO3
4	**Power Electronics Control in BEV & HEV**	**Battery Electrical vehicle (BEV)**: Components of BEV drive train, The electric propulsion subsystem - Power converter, Driving wheels, Suspension system, Driveshaft, Mechanical transmission, Electric Motor, power electronics converters (DC-AC/DC-DC), The electronic control unit (ECU), regenerative braking system in EVs. **Hybrid Electric Vehicle (HEV)** -Basic architecture of hybrid drive trains, Components of HEV drive train system. Classification of HEV. Fuel efficiency in BEV & HEV	8	CO4

5	**Maintenance & Protection in EVs**	Electric vehicle maintenance (Battery, Sensors, etc.), Dos & don'ts for Electric Vehicle, Precautions to be taken to avoid fire due to electrical faults. Thermal management system in EV, Overcurrent, Overvoltage, and Undervoltage protection in EVs. Role of fuses and circuit breaker in EVs.	8	CO5

Reference Books:
1. Electric & Hybrid Vehicles – Design Fundamentals – Iqbal Hussain, Second Edition, CRCPress, 2011.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals – Mehrdad Ehsani,Yimin Gao, Ali Emadi, CRC Press, 2010.
3. Rao, B V S Asia Club House, First Reprint, 2011, Operation and Maintenance of Electrical Equipment Vol-I,
4. Mohan, Undeland, Robbins: Power Electronics: Converters, Applications and Design. 3rd Edition. John Wiley & Sons, 2003
e-Learning Source:
1. https://www.udemy.com/course/power-electronics-for-electric-vehicles/?srsltid=AfmBOoqM2ketcIQf8Nlj_lVe_V4uVZNEGxAcHyEdLZQMb2x12PoPW-HJ&couponCode=NEWYEARCAREER
2. https://www.youtube.com/watch?v=z_oxLH4gWbU
3. https://www.youtube.com/watch?v=9mO-WUB3KVQ
4. https://www.youtube.com/watch?v=nrxmQhbZUTc

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

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