COURSE BOOK B. TECH. II YEAR

Electrical & Electronics Engineering

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CURRICULUM STRUCTURE & SYLLABUS

Effective from the Session: 2025-26

B.Tech (EEE) 3rd Sem

S No.	Course Category (AICTE)	Course Category (UGC)	BOS	Course Code	Course Name	Type	Academic Learning (AL)			Continuous Internal Examination (CIE)			End Sem Examination (ESE)	Total Marks	Total Credits
							L	T	P	MSE	CA	TOTAL		CIE+ ESE	
1	PC	Major (Core)	EEE	EE106L	Signals & Systems	L	2	0	0	40	10	50	50	100	2
2	PC	Major (Core)	EEE	EE107L	Electrical Measurements and Data Acquisition	L	3	0	0	60	15	75	75	150	3
3	BS	Major (Core)	ASH	MA105L	Probability and Statistics	L	3	0	0	60	15	75	75	150	3
4	PC	Major (Core)	EEE	EE202L	Electrical Machine-I	L	3	0	0	60	15	75	75	150	3
5	PC	Major (Core)	EEE	EE108L	Analog Electronics	L	2	0	0	40	10	50	50	100	2
6	MC	Value Added	ASH	HS109L	Constitution of India	L	2	0	0	25	-	25	25	-	NC
7	HS	AEC	ASH	HS110L	Aptitude-1	L	1	0	0	-	25	25	25	50	1
8	HS	AEC	ASH	HS111L	Soft Skills Essential-1	L	1	0	0	-	25	25	25	-	NC
Blended															
9	ES	Major (Core)	ELCE	EL106B	Introduction to AI & ML	B	2	0	2	60	15	75	75	150	3
10	PE	Major (Core)/SEC	-	-	Professional Elective-I	B	3	0	2	80	20	100	100	200	4
Lab/Practical															
11	PC	Major (Core)	EEE	EE107P	Electrical Measurements and Data Acquisition Lab	P	0	0	2	-	25	25	25	50	1
12	PC	Major (Core)	EEE	EE202P	Electrical Machine-I Lab	P	0	0	2	-	25	25	25	50	1
13	PC	Major (Core)	EEE	EE108P	Analog Electronics Lab	P	0	0	2	-	25	25	25	50	1
14	PW	Summer internship	CSIT	IT105P	Social Internship Assessment	P	0	0	0	-	50	50	-	50	1
Total Hours : 32 hrs.							**22**	**0**	**10**					**1250**	**25**

Professional Electives (PE)

S.No.	Course Type (PE)	Basket-1 (AI and Data-Driven Smart Grid Technologies) Powered by: Tata Power DDL, Delhi	Basket-2 (Intelligent Electric Vehicle) Powered by: Imperial Society of Innovative Engineers and National Skill Development Corporation (NSDC)	Basket-3 (Next-Gen Automation: IIoT & Gateways) Powered by: Usha Automation, India and Phoenix Contact, Germany
1	**BOS**	**ELCE**	**EEE**	**EEE**
	PE I-(3rd Sem)	Smart Grid Fundamentals and Applications (EL206E)	Modelling Dynamic Systems and Physical Components using MATLab (EE205E)	Sensors & Automation Essentials (EE207E)

B. Tech (EEE) 4th Sem

S No.	Course Category (AICTE)	Course Category (UGC)	BOS	Course Code	Course Name	Type	Academic Learning (AL)			Continuous Internal Examination (CIE)			End Sem Examination (ESE)	Total Marks	Total Credits
							L	T	P	MSE	CA	TOTAL		CIE+ ESE	
1	PC	Major (Core)	EEE	EE203L	Electrical Machine-II	L	3	1	0	80	20	100	100	200	4
2	PC	Major (Core)	EEE	EE204L	Control Systems	L	3	0	0	60	15	75	75	150	3
3	PC	Major (Core)	EEE	EE109L	Network Analysis and Synthesis	L	3	1	0	80	20	100	100	200	4
4	ES	Major (Core)	EEE	EE110L	Data Base and Applications	L	2	0	0	40	10	50	50	100	2
5	MC	Value Added	ASH	HS112L	Universal Human Values	L	3	0	0	60	15	75	75	150	3
6	HS	AEC	ASH	HS113L	Aptitude-2	L	1	0	0	-	25	25	25	50	1
7	HS	AEC	ASH	HS114L	Soft Skills Essential 2	L	1	0	0	-	25	25	25	-	NC
Blended															
8	PE	Major (Core)/SEC	-	-	Professional Elective-II	B	3	0	2	80	20	100	100	200	4
Lab/Practical															
9	PC	Major (Core)	EEE	EE203P	Electrical Machine-II Lab	P	0	0	2	-	25	25	25	50	1
10	PC	Major (Core)	EEE	EE204P	Control Systems Lab	P	0	0	2	-	25	25	25	50	1
11	PC	Major (Core)	EEE	EE109P	Network Analysis and Synthesis Lab	P	0	0	2	-	25	25	25	50	1
12	ES	Major (Core)	EEE	EE110P	Data Base and Applications Lab	P	0	0	2	-	25	25	25	50	1
Total Hours : 31 hrs.							**19**	**2**	**10**					**1250**	**25**

Professional Electives (PE)

S.No.	Course Type (PE)	Basket-1 (AI and Data-Driven Smart Grid Technologies) Powered by: Tata Power DDL, Delhi	Basket-2 (Intelligent Electric Vehicle) Powered by: Imperial Society of Innovative Engineers and National Skill Development Corporation (NSDC)	Basket-3 (Next-Gen Automation: IIoT & Gateways) Powered by: Usha Automation, India and Phoenix Contact, Germany
2	**BOS**	**ELCE**	**EEE**	**EEE**
	PE II-(4th Sem)	AI and Machine Learning for Smart Grids (EL207E)	Integration of Systems of EVs (EE206E)	Integration of SCADA and PLC with IIOT Gateways (EE208E)

Theory Courses Detail Syllabus

Course Code: EE106L	Course Name: Signals & Systems	L	T	P	C
		2	0	0	2

Pre-requisite: Basic knowledge of Engineering Mathematics (Differential Equations, Calculus, and Linear Algebra).

Course Objectives: Gain foundational skills essential for advanced studies in electrical and communication engineering.

Course Outcome: After completion of the course, the student will be able to

1. Understand different types of signals and systems and perform basic operations such as time-shifting, scaling, and folding.
2. Apply Fourier series and Fourier transform techniques to analyze periodic and aperiodic signals in the frequency domain.
3. Analyze ordinary differential equations and evaluate continuous-time system behavior using Laplace transform techniques.
4. Analyze linear difference equations and assess the stability and response of discrete-time systems using Z-transform methods.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Introduction to Signals & Systems	08 hours

Continuous and Discrete-Time Signals, Periodic, Aperiodic, Even, Odd Signals, Energy, Power, Deterministic, and Random Signals, System Properties: Linearity, Time-Invariance, Causality, Stability, Impulse Response and Convolution, LTI Systems, Basic Signal Operations: Shifting, Scaling, Folding.

Unit 2	Fourier Analysis of Signals:	08 hours

Fourier Series: Representation of Periodic Signals, Properties. Fourier Transform: Fourier Transform of Aperiodic Signals, Properties, Frequency Domain Analysis.

Unit 3	Laplace Transform & Applications	07 hours

Definition and Properties, Inverse Laplace Transform, Transfer Function Representation, Stability Analysis using Poles and Zeros, Solving Differential Equations using Laplace Transform, Relationship between Laplace and Fourier Transform.

Unit 4	Z-Transform & Discrete-Time System Analysis	07 hours

Definition, ROC, and Properties of Z-Transform, Inverse Z-Transform, Solving Difference Equations using Z-Transform, Discrete-Time LTI System Analysis, Relationship between Z-Transform and Laplace Transform.

Total Lecture Hours	30 hours

Textbook:

1. Signals and Systems by P. Ramesh Babu and R. Ananda Natarajan, SciTech Publications.
2. Signals and Systems by Tarun Kumar Rawat, Oxford University Press.

Reference Books:

1. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky, and Nawab, Prentice Hall
2. Signals and Systems by Simon Haykin and Barry Van Veen, Wiley-India Publications
3. Linear Systems and Signals by B.P. Lathi, Oxford University Press

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
20	20	4	4	2	50	100
40		10				

Course Code: EE107L	Course Name: Electrical Measurements and Data Acquisition	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Electrical Engineering

Course Objectives:

1. The course aims to provide knowledge and analytical skills for understanding and applying DC and AC bridge circuits to accurately and precisely measure electrical parameters.
2. It aims to train students to develop, implement, and apply data acquisition systems using hardware and software tools.

Course Outcome: After completion of the course, the student will be able to

1. Understand the principles and components of electrical measurement systems.
2. Understand bridge circuits for precise measurement and error evaluation.
3. Apply methods to measure voltage, current, power, energy, and power factor.
4. Understand digital instruments and oscilloscopes for signal analysis.
5. Apply data acquisition systems using MATLAB and Arduino in practical applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Fundamentals of Electrical Measurements	09 hours

Introduction to Electrical Measurements: Importance and Applications. Measurement System Components: Sensors, Transducers, Signal Conditioning, and Data Acquisition. Characteristics of instruments, Accuracy, Precision, Resolution, and Errors in Measurement, IEEE Standards and Calibration of Measuring Instruments.

Unit 2	Bridge Circuits and Precision Measurement Techniques	09 hours

DC Bridges: Wheatstone Bridge, Kelvin Bridge for Low Resistance Measurement. AC Bridges: Maxwell's Bridge, Hay's Bridge, Anderson's Bridge, Schering Bridge, Wien Bridge. Error Analysis in Bridge Measurements.

Unit 3	Measurement of Electrical Quantities	09 hours

Measurement of voltage, current, power, energy and power factor. Instrument Transformers: Current Transformer (CT) and Potential Transformer (PT).

Unit 4	Digital Measurement Instruments and Oscilloscopes	09 hours

Digital Voltmeters (DVM) and Digital Multimeters (DMM). Measurement of Phase, Time, and Frequency. Digital Storage Oscilloscope (DSO).

Unit 5	Data Acquisition	09 hours

Introduction to Data Acquisition Systems (DAS). Analog to Digital (ADC) and Digital to Analog Conversion (DAC). Hardware and Software for Data Acquisition (MATLAB, Arduino). Applications in Industrial Automation, Smart Grid, and Renewable Energy Monitoring.

	Total Lecture Hours	45 hours

Textbook:

1. J.B. Gupta, A Course in Electronic and Electrical Measurements and Instrumentation, S.K. Kataria & Sons, 2024.
2. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co., 2015.
3. E.W. Golding & F.C. Widdis, Electrical Measurements and Measuring Instruments, Wheeler Publishing, 5th Edition, 2016.
4. D.V.S. Murthy, Transducers and Instrumentation, Prentice Hall of India, 2nd Edition, 2008.
5. "Data Acquisition Toolbox for Use with MATLAB: User's Guide" by MathWorks, 2020.

Reference Books:

1. J.G. Webster, The Measurement, Instrumentation, and Sensors Handbook, CRC Press, 2nd Edition, 2017.
2. R. Khandpur, Handbook of Analytical Instruments, Tata McGraw-Hill, 3rd Edition, 2020.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
30	30	6	6	3	75	150
60		15				

Course Code: MA105L	Course Name: Probability & Statistics	L	T	P	C
		3	0	0	3

Pre-requisite: X+2

Course Objectives:

1. To familiarize the graduate engineers with the concept of Statistics and Probability.
2. It aims to analyze the practical/ real life problems and solve them in scientific manner.

Course Outcome: After completion of the course, the student will be able to

1. Employ the concept of measure central tendency and regression analysis.
2. Apply knowledge of probability on distribution function.
3. Apply the concept of probability density function and normal distribution.
4. Apply the concept of random variable and time series.
5. Employ the knowledge of hypothesis by means of Chi-square and ANOVA test.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Basic Statistics	09 hours

Introduction to Descriptive Statistics, Measure of Central Tendency, Histogram in sampling, Method of least square (basic concept), Fitting of Straight line and exponential curve, Correlation, Rank correlation and Regression Analysis.

Unit 2	Probability I	09 hours

Probability, Law of total Probability, Conditional Probability, Baye's Theorem, Discrete Random Variable, Probability Mass function. Binomial Distribution, Poisson Distribution., Introduction to confusion matrix.

Unit 3	Probability II	09 hours

Continuous Random Variable, Probability density function, Properties of Probability density function, Expectation and variance, Normal Distribution and its applications.

Unit 4	Bivariate Random Variable and Time Series	09 hours

Introduction to two dimensional random variable, Joint probability density function and its properties, Marginal probability distribution, Introduction to Time series, component of time series, Measure of trend (Graphic method, method of Averages)

Unit 5	Sampling Theory	09 hours

Introduction to Inferential Statistics, Testing of Hypothesis: Introduction, Sampling Theory (Small and Large), Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, t-test, Chi-square test, one way analysis of variance (ANOVA).

Total Lecture Hours	45 hours

Textbook:

1. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2017
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2017.
3. R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.
4. S. C. Gupta & V. K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand & Sons.

Reference Books:

1. Seymour Lipschutz, John Schiller, Introduction to Probability and Statistics, McGraw Hill
2. Peter V. O'Neil, Advance Engineering Mathematics, Thomson (Cengage) Learning, 2007.
3. TKV Iyenger, B. Krishna Gandhi, S. Ranganatham, MVSN Prasad, Probability and Statistics (S. Chand Publishing House).
4. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
30	30	6	6	3	75	150
60		15				

Course Code: EE202L	Course Name: Electrical Machines-I	L	T	P	C
		3	0	0	3

Pre-requisite: Knowledge of Basic Electrical Engineering and Engineering Mathematics.

Course Objectives:
Aim to enable the students to analyze, design, and troubleshoot issues related to DC machines and transformers through numerical problems and laboratory experiments.

Course Outcome: After completion of the course, the student will be able to
1. Analyze the various principles & concepts involved in Electromechanical Energy Conversion.
2. Demonstrate the constructional details of DC machines.
3. Evaluate the performance and characteristics of DC Machine as motor and as well as generator.
4. Evaluate the performance of transformers, individually and in parallel operation.
5. Demonstrate and perform various connections of three phase transformers.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Principles of Electro-Mechanical Energy Conversion	09 hours

Introduction, Review of magnetic system, Energy in Magnetic system, Force and torque in magnetic field system, Energy balance equation, Energy conversion via electrical field, Energy in a singly excited system, Determination of the Force and Torque from energy and co-energy, Generation of EMF in Machines, Torque in machine with cylindrical air gap.

Unit 2	Construction and Types of DC Machines	09 hours

Construction, types of DC machines, Armature winding (Concentrated and Distributed), Winding Factor, Armature reaction, Commutation, Interpoles and compensating windings, Performance characteristics of DC generators, Applications.

Unit 3	Performance and Control of DC Machines	09 hours

Performance characteristics of DC motors, Starting of DC motors; 3 point and 4 point starters, Speed control of DC motors; Field control, Armature control and Voltage control (Ward Leonard method); Efficiency and Testing of DC machines (Hopkinson's and Swinburne's Test), Applications.

Unit 4	Single Phase Transformer	09 hours

Construction and Working, Efficiency and voltage regulation, all day efficiency, Excitation phenomenon and harmonics in transformers. Testing of Transformers- O.C. and S.C. tests. Auto Transformer, Volt-amp relation, Copper saving in autotransformer, Merits, demerits, and applications.

Unit 5	Three Phase Transformer	09 hours

Construction of 3-ϕ transformer, phasor groups and their connections, open delta connection, 3-ϕ to 2-ϕ and their applications, Three winding transformers. Parallel operation of 1-ϕ and 3-ϕ transformers and load sharing.

Total Lecture Hours	45 hours

Textbook:
1. Bimbhra, P. S. Electrical Machinery, Khanna Publishers.
2. Kothari, D. P., & Nagrath, I. J. *Electric Machines*, McGraw Hill Education.
3. Fitzgerald, A. E., Kingsley, C., & Umans, S. D. (2013) *Electric Machinery* (7th ed.) McGraw Hill.

Reference Books:
1. Langsdorf, A. S. Theory of Alternating Current Machinery (2nd ed.) Tata McGraw Hill.
2. Say, M. G. Performance and Design of AC Machines (3rd ed.) CBS Publishers.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
30	30	6	6	3	75	150
60		15				

Course Code: EE108L	Course Name: Analog Electronics	L	T	P	C
		2	0	0	2

Pre-requisite: Basic Electronics Engineering

Course Objectives: Aim to design different types of amplifiers and oscillators.

Course Outcome: After completion of the course, the student will be able to

1. Explain the working and characteristics of semiconductor devices like diodes, BJTs, and FETs.
2. Analyze and design rectifiers, amplifiers, and oscillators using semiconductor devices.
3. Apply operational amplifiers in various linear and nonlinear applications.
4. Analyze and design feedback amplifiers, oscillators and multivibrator.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Semiconductor Diodes and Applications	06 hours

PN Junction Diode: Characteristics & Operation , Zener Diodes & Voltage Regulation, LED, Photodiodes, and Optoelectronic Devices, Rectifiers: Half-Wave, Full-Wave, Bridge Rectifiers, Filters and Voltage Regulation

Unit 2	Bipolar Junction Transistors (BJTs) & Field Effect Transistors (FETs)	10 hours

BJT Construction, Operation & Characteristics, Current Gain (β), Load Line Analysis, BJT Biasing Techniques Fixed bias and Voltage Divider bias, BJT Amplifiers: Common Emitter, Frequency Response of BJT Amplifiers, FET: Structure, Characteristics, and Operation, FET as an Amplifier & Switch, MOSFET Applications in Power Electronics

Unit 3	Operational Amplifiers (Op-Amps) and Applications	07 hours

Op-Amp Basics: Ideal & Practical Characteristics, Op-Amp Configurations: Inverting, Non-Inverting, Voltage Follower, Applications: Summing, Differentiator, Integrator, Comparator, Active Filters: Low-Pass, High-Pass, Band-Pass, All Pass Filter, Square and Triangular Waveform Generators

Unit 4	Feedback and Oscillators	07 hours

Positive and Negative Feedback, Feedback Topologies & Stability Criteria, Sinusoidal Oscillators (RC Phase Shift, Wien Bridge, Colpitts, Hartley), IC 555 Timer : Monostable, Bistable, Astable multivibrator

Total Lecture Hours	30 hours

Textbook:

1. Sedra & Smith – Microelectronic Circuits, Oxford University Press
2. Millman & Halkias – Integrated Electronics: Analog and Digital Circuits and Systems, McGraw Hill
3. Boylestad & Nashelsky – Electronic Devices and Circuit Theory, Pearson

Reference Books:

1. Malvino & Bates – Electronic Principles, McGraw Hill
2. Robert L. Boylestad – Introductory Circuit Analysis, Pearson
3. Sanjeev Gupta – Electronic Devices and Analog Circuits, PHI Learning
4. A. S. Sedra, K. C. Smith – Microelectronic Circuits, Oxford University Press

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
20	20	4	4	2	50	100
40		10				

Course Code: HS109L	Course Name: Constitution of India	L	T	P	C
		2	0	0	NC

Pre-requisite: NA

Course Objectives:

1. To acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To channelize students' thinking towards basic understanding of the legal concepts and its implications for

engineers.
4. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

Course Outcome: After completion of the course, the student will be able to
1. Understand basic features and modalities about Indian constitution.
2. Clarify the functioning of Indian parliamentary system at the center and state level.
3. Understand the aspects of Indian Legal System and its related bodies.
4. Apply different laws and regulations related to engineering practices.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	2	-	-	-	2
CO2	-	-	-	-	-	-	1	1	1	-	-	2
CO3	-	-	-	-	-	-	1	1	1	-	1	2
CO4	-	-	-	-	-	-	1	2	1	1	1	2

Unit 1	Basic Information about Indian Constitution	08 hours

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Unit 2	Union Executive and State Executive	08 hours

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, Lok Pal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Unit 3	Basic Information about Legal System	07 hours

The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

Unit 4	Election provisions, Emergency provisions, Amendment of the constitution	07 hours

Election Commission of India-composition, powers and functions and electoral process. Types of emergency-grounds, procedure, duration and effects. Amendment of the constitution- meaning, procedure and limitations

	Total Lecture Hours	30 hours

Textbook:

1. Brij Kishore Sharma: *Introduction to the Indian Constitution*, 8th Edition, PHI Learning Pvt. Ltd.
2. Granville Austin: *The Indian Constitution: Cornerstone of a Nation (Classic Reissue)*, Oxford University Press.
3. S.G Subramanian: *Indian Constitution and Indian Polity*, 2nd Edition, Pearson Education 2020.
4. Subhash C. Kashyap: *Our Constitution: An Introduction to India's Constitution and constitutional Law*, NBT, 2018.
5. Madhav Khosla: *The Indian Constitution*, Oxford University Press.
6. PM Bakshi: *The Constitution of India*, Latest Edition, Universal Law Publishing.
7. V.K. Ahuja: *Law Relating to Intellectual Property Rights* (2007)
8. Suresh T. Viswanathan: *The Indian Cyber Laws, Bharat Law House*, New Delhi-88
9. P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
10. Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36).https://www.icsi.edu/media/webmodules/publications/Company%20Law.pdf
11. Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e- Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

12. Companies Act, 2013 Key highlights and analysis by PWC. https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights- and-analysis.pdf

Reference Books:

1. Keshavanand Bharati V. State of Kerala, AIR 1973 SC 1461.
2. Maneka Gandhi V. Union of India AIR, 1978 SC 597.
3. S.R. Bammai V. Union of India, AIR 1994 SC 1918.
4. Kuldip Nayyar V. Union of India, AIR 2006 SC312.
5. A.D.M. Jabalpur V. ShivkantShakla, AIR 1976 SC1207.
6. Remshwar Prasad V. Union of India, AIR 2006 SC980.
7. Keshav Singh in re, AIR 1965 SC 745.
8. Union of India V. Talsiram, AIR 1985 SC 1416.
9. Atiabari Tea Estate Co.V. State of Assam, AIR 1961SC232.
10. SBP & Co. Vs. Patel Engg. Ltd. 2005 (8) SCC 618.
11. Krishna Bhagya Jala Nigam Ltd. Vs. G. Arischandra Reddy (2007) 2 SCC 720.
12. Oil & Natural Gas Corporation Vs. Saw Pipes Ltd. 2003 (4) SCALE 92 – 185.
13. Contemporary Newer case studies can be developed using AI tools
14. ** (Other relevant case studies can be consulted by the teacher as per the topic). Prescribed Legislations:
15. Information Technology Act, 2000 with latest amendments. **Compare this with GDPR of Europe**
16. RTI Act 2005 with latest amendments.
17. Information Technology Rules, 2000
18. Cyber Regulation Appellate Tribunal Rules, 2000 Suggested aid for Students and Pedagogic purpose
19. RSTV debates on corporate law, IPR and patent issues
20. NPTEL lectures on IPR and patent rights

Episodes of 10 -part mini TV series "Samvidhan: The Making of Constitution of India" by RSTV.

Mode of Evaluation:

MSE		CA			ESE	Total	
MSE	MSE2	CA1	CA2	CA4 (ATT)			
-	25	-	-	-	25	NC	
25		-					

Course Code: HS110L	Course Name: Aptitude-1	L	T	P	C
		1	0	0	1

Pre-requisite: NA

Course Objectives:

1. To provide adequate exposure to the students regarding the use of aptitude tests in the recruitment process and competitive examinations.
2. To improve the logical & numerical ability of the students.

Course Outcome: After completion of the course, the student will be able to

1. Illustrate their comprehension by solving the given problems
2. Apply the learned concepts to new problems and solve them aptly.
3. Make use of their thought process to interpret and draw inferences from the given data to reach logical conclusions.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	1	-	1	-	-	-	-	-	1
CO2	1	1	-	1	-	2	-	-	-	-	-	1
CO3	1	1	-	1	-	1	-	-	-	-	-	2

Unit 1	Series, Coding and Decoding	04 hours

Importance and overview of Quantitative Aptitude and Logical Reasoning, Number Series, Letter Series, Analogies, Coding and Decoding.

Unit 2	Data Arrangement	04 hours

Ranking and Order, Direction Sense, Linear and Circular sitting arrangement.

Unit 3	Blood Relation and Puzzles	03 hours

Basic concepts, definition and terminology related to blood relationships, Conversation-based blood relationships, Family Tree-based problems, Coded relationships and related puzzles.

Unit 4	Critical and Non-Verbal Reasoning	04 hours

Statement arguments, course of action, classification and grouping of images, Figure series, Mirror image, Water image, Paper cutting, Paper folding, Embedded figures.

Total Lecture Hours | **15 hours**

Textbook:

1. A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publication.

Reference Books:

1. How to Prepare for Logical Reasoning for the CAT" by Arun Sharma, TMH Publication.

Mode of Evaluation:

CA			ESE	Total
CA1	CA2	CA3(ATT)		
10	10	5	25	50
25				

Course Code: HS111L	Course Name: Soft Skills Essentials-1	L	T	P	C
		1	0	0	NC

Pre-requisite:

- Students should have foundational knowledge of grammar, vocabulary, and sentence structure to participate effectively in tasks like extempore, scenario writing after studying Communication skills subject in first year.
- Prior exposure to basic communication concepts (like verbal/non-verbal communication and listening skills) helps students to enhance persuasion, negotiation, and professional etiquette.

Course Objectives:

To develop students' communication, presentation, and interpersonal skills through interactive activities, elevating confidence and professionalism for academic and workplace success

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate improved self-awareness and communication skills through structured presentations and vocabulary-building activities.
2. Apply effective verbal communication techniques, including pronunciation and elevator pitch delivery, to express ideas clearly and confidently.
3. Exhibit professional behaviour, grooming, and teamwork skills in group discussions, interviews, and workplace-related role plays.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	-	1
CO2	-	-	-	-	-	-	-	-	2	3	-	2
CO3	-	-	-	-	-	-	-	-	2	3	-	2

Unit 1	Foundation of Communication and Self-Awareness	05 hours
British Council-English Score Test, Team Presentations on Change Management Models, Presentations on Personality Profiling for professional growth		
Unit 2	**Verbal Communication and Clarity**	**04 hours**
Pronunciation Drill 1 & 2, Elevator Pitch Practice Session 1 & 2		
Unit 3	**Professionalism and Workplace Readiness**	**06 hours**
Professional Grooming and Etiquette, Group Discussion (General Topics), Panel Discussion on workplace scenarios using caselets		

Total Lecture Hours | **15 hours**

Useful Resources:

1. www.mindtools.com
2. https://englishonline.britishcouncil.org/
3. www.toastmasters.org
4. https://www.futurelearn.com/
5. English Score Test
6. Duo Lingo Test

Mode of Evaluation

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
-	-	10	10	5		
-		25			25	50

Course Code: EL106B	Course Name: Introduction to AI & ML	L	T	P	C
		2	0	2	3

Pre-requisite: Knowledge of Mathematics in Secondary Education and basic Programming skills

Course Objectives:

Provide core engineering students with a foundational understanding of artificial intelligence, machine learning, and reinforcement learning, with practical implementation skills using Python.

Course Outcome: After completion of the course, the student will be able to

1. Understand fundamental concepts of AI and implement basic search algorithms
2. Apply various machine learning algorithms to solve real-world problems
3. Develop deep learning models using modern frameworks
4. Implement reinforcement learning algorithms for decision-making problems
5. Create end-to-end machine learning projects using Python.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1 | **Introduction to Artificial Intelligence** | **12 hours**

Introduction to Artificial Intelligence, Types of AI: Weak AI vs Strong AI, Problem Solving and Search Algorithms- State Space Search, Uninformed Search Strategies (BFS, DFS), Informed Search Strategies (A*, Best First Search)

Problems:

- Write a program to simulate a simple rule-based chatbot using if-else or pattern matching.
- Write a program to compare Weak AI and Strong AI through Tic-Tac-Toe and a basic Turing Test interface.
- Write a program to generate and display the state space tree for the 8-puzzle problem up to a certain depth.
- Write a program to implement Best First Search using a heuristic function to guide the search.
- Write a program to implement the A* algorithm for pathfinding in a weighted graph or grid.

Unit 2 | **Introduction to Machine Learning** | **12 hours**

Fundamentals of Machine Learning, Supervised vs Unsupervised Learning, Training, Validation, and Testing. Data Preprocessing- Data Cleaning, Feature Scaling, Feature Selection, Handling Missing Values. Linear Regression and Logistic Regression

Problems:

- Write a program to demonstrate the difference between Supervised and Unsupervised Learning using appropriate datasets.
- Write a program that splits a dataset into training, validation, and test sets and prints their sizes.
- Write a program to clean a dataset by removing duplicates, handling missing values, and encoding categorical features.
- Write a program to apply feature scaling using StandardScaler and MinMaxScaler on numerical data.
- Write a program to perform feature selection using correlation matrix and SelectKBest method.
- Write a program to implement Linear Regression on a dataset and evaluate its performance using RMSE and R^2 score.

Unit 3 | **Advanced Machine Learning Algorithms** | **10 hours**

K-Means Clustering, Support Vector Machines- Linear and Non-linear SVM, Kernel Functions, Decision Trees and Random Forests,

Problems:

- Write a program to implement K-Means clustering on a dataset and visualize the clusters.
- Write a program to train a Linear SVM classifier on the Iris dataset and evaluate its accuracy.
- Write a program to implement a Non-Linear SVM classifier using a radial basis function (RBF) kernel.
- Write a program to demonstrate the effect of different kernel functions (linear, polynomial, RBF) on SVM performance.
- Write a program to implement a decision tree classifier and visualize the decision tree

Unit 4 | **Reinforcement Learning** | **13 hours**

Fundamentals of Reinforcement Learning- Markov Decision Processes, States, Actions, and Rewards, Value Functions and Policies. Q-Learning- Q-Table and Q-Function, Exploration vs Exploitation, Epsilon-Greedy Strategy. Applications in Gaming and Robotics

Problems:

- Write a program to simulate a simple Markov Decision Process (MDP) with 3 states and 2 actions. Show state transitions and rewards using a transition probability matrix.
- Write a program to implement Q-Learning for a small grid environment (e.g., 4x4 frozen lake). Use a Q-table to learn the best actions from each state.
- Write a program to compare the effect of different exploration strategies (greedy, epsilon-greedy, and softmax) on the learning process in Q-Learning.
- Write a program where an agent learns to play a simple game (e.g., Tic-Tac-Toe or a custom maze) using Q-learning
- Write a program to visualize how Q-values evolve over time in a simple environment using Epsilon-Greedy strategy with decay

Unit 5	**Deep Learning**	**13 hours**

Neural Networks Basics- Perceptron, Activation Functions, Backpropagation, Multi-layer Neural Networks, Introduction to Convolutional Neural Networks, Introduction to Recurrent Neural Networks- RNN Architecture, LSTM and GRU, Sequence Prediction. Deep Learning Frameworks- Introduction to TensorFlow, Model Building and Training.

Problems

- Write a program to implement a single-layer Perceptron for binary classification.
- Write a program to plot and compare common activation functions (Sigmoid, Tanh, ReLU, Leaky ReLU).
- Write a program to implement backpropagation in a multi-layer feedforward neural network from scratch.
- Write a program to build and train a neural network using TensorFlow's Keras API for a classification task.

Total Lecture Hours	**60 hours**

Textbook:

1. S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed. Upper Saddle River, NJ, USA: Pearson, 2020.
2. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, 3rd ed. Sebastopol, CA, USA: O'Reilly Media, 2022.
3. R. S. Sutton and A. G. Barto, *Reinforcement Learning: An Introduction*, 2nd ed. Cambridge, MA, USA: MIT Press, 2018.

Reference Books:

1. C. M. Bishop, *Pattern Recognition and Machine Learning*. New York, NY, USA: Springer, 2006.
2. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. Cambridge, MA, USA: MIT Press, 2016.
3. S. Raschka and V. Mirjalili, *Python Machine Learning*, 2nd ed. Birmingham, UK: Packt Publishing, 2017.
4. T. Hastie, R. Tibshirani, and J. Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, 2nd ed. New York, NY, USA: Springer, 2009.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
30	30	6	6	3	75	150
60		15				

Course Code: EL206E	Course Name: Smart Grid Fundamentals and Applications	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To provide a foundational understanding of the Smart Grid and its architecture.
2. To introduce key enabling technologies like AI/ML, AMI, PMUs, IoT, and cyber-physical systems in smart grids.
3. To demonstrate the integration of renewable energy sources and distributed generation in the modern grid.
4. To impart skills for data-driven analysis, fault detection, and demand-response systems.
5. To expose students to industry practices through Tata Power-DDL use cases and real-world implementations.

Course Outcome: After completion of the course, the student will be able to

1. Understand the core architecture, features, and components of a Smart Grid.
2. Explain the role of ICT, AMI, and data acquisition in modern energy systems.
3. Apply AI/ML techniques for load forecasting, fault diagnosis, and predictive maintenance.
4. Analyze and evaluate case studies and deployment strategies in Smart Grid applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Smart Grid Concepts and Architecture	19 hours

Conventional grid vs. smart grid, Smart grid functions and benefits, Smart grid architecture: generation, transmission, distribution, DERs, Roles of utilities, prosumers, and regulators, Smart Grid Components (smart meters, sensors, energy management systems), Distributed Generation (DG), microgrids, and virtual power plants (VPPs).

Activities:

- Simulate power flow for both traditional and smart grid models in MATLAB/Simulink.
- Visualize smart grid parameters (voltage, current, frequency) using SCADA platforms.

Unit 2	Enabling Technologies in Smart Grid	19 hours

Smart meters and their functionality, Advanced Metering Infrastructure (AMI), AMI components (HAN, NAN, WAN), Communication protocols (ZigBee, RF Mesh, Power Line Communication), 5G, Interoperability and data standards, Phasor Measurement Units (PMUs), SCADA, Smart substations, and remote terminal units.

Activities:

- Load forecasting using regression and neural networks Activities
- Simulate or import sample smart meter data (e.g., hourly consumption) in Python or Excel.
- Interface sensors with microcontrollers to emulate energy monitoring and wireless data transmission.

Unit 3	Data Analytics and AI/ML Applications	19 hours

Data acquisition and preprocessing for Smart Grids, Load forecasting using ML (regression, neural networks), Fault detection and diagnostics, Demand response, load shaping, and predictive maintenance using AI/ML

Activities:

- Use historical data to forecast short-term load demand using linear regression in Python.
- Apply FFT in MATLAB or Python on current/voltage signals to detect abnormal grid behavior.

Unit 4	Real-World Applications and Case Studies	18 hours

Tata Power DDL Delhi Smart Grid initiatives, Real-time pricing and smart billing systems, Cybersecurity and privacy concerns in smart grid environments, Regulatory framework, standards (IEEE 1547, IEC 61850), and policy interventions.

Activities:

- Simulate dynamic pricing algorithms based on grid demand and implement a simple billing system.
- Develop a dashboard or chart showing the evolution of smart grid policies (e.g., IEEE 1547 compliance) and their technical implications.

Total Lecture Hours	75 hours

Textbook:

1. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley
2. S. M. Islam, Smart Grid Systems: Modeling and Control, CRC Press.

Reference Books:

1. Krzysztof (Kris) Iniewski, Smart Grid Infrastructure & Networking, McGraw-Hill
2. Elissaios Sarmas, Vangelis Marinakis, Haris Doukas, Artificial Intelligence for Energy Systems (Driving Intelligent, Flexible and Optimal Energy Management), Springer
3. Tata Power-DDL Whitepapers, Technical Reports, and Use Cases.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE205E	Course Name: Modelling Dynamic Systems and Physical Components using MATLAB	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

Aim to equip the students with the skills to model, simulate, and analyze dynamic physical systems using MATLAB and Simulink, with a focus on real-world vehicle applications.

Course Outcome: After completion of the course, the student will be able to

1. Explain the fundamentals and classification of dynamic systems and models.
2. Apply MATLAB programming and plotting techniques to simulate basic dynamic systems.
3. Develop dynamic system models using bond graphs and simulate using Simulink.
4. Design and simulate vehicle subsystems such as engine, drivetrain, and braking.
5. Interpret simulation data and evaluate the behavior of vehicle dynamic systems.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	**Fundamentals of Dynamic System and Modelling**	**15 hours**

Introduction to dynamic systems and need for modeling, Classification of Models- Scaled physical model, Mathematical model, Case study of passenger vehicle suspension system depicting model theories, Principles used in Modelling, Modeling of Dynamic systems, Transfer Function Models and State-space model, First and Second order, Need for Simulation.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Modeling and Simulation of a DC Motor Using State-Space Representation
- Simulink-Based Simulation of Dynamic Systems for Input Disturbance Analysis
- Simulation of a Quarter Car Suspension System Using Transfer Function Approach

Unit 2	**MATLAB as a Simulation Tool**	**15 hours**

Comparison of Analytical and Simulation methods, Types of Simulation – Continuous and Discrete Event, MATLAB as simulation tool, Demonstration of MATLAB Environment- Basics of MATLAB Programming and execution, Function statements and Plotting, Example- Modeling of Power window actuation system, solving equation using MATLAB, Introduction to Simulink – Blocks introduction, Mass-Spring-Damper system solving in MATLAB

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Analytical vs. Simulation-Based Response of a Mass-Spring-Damper System Using MATLAB
- Introduction to MATLAB Programming: Solving Differential Equations and Plotting System Response

Unit 3	**Bond Graphs and Modeling systems in MATLAB**	**15 hours**

Bond Graph- Requirement, Advantages and Power Variables, Causality, Basic System Elements- electrical, mechanical and thermal, Simulation of models using Simulink, Sources→systems→sinks, building a Simulink model, simulation parameters, modifying subsystems parameters, simulation output.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Modeling and Simulation of an Electro-Mechanical System Using Bond Graphs and Simulink
- Parameter Modification and Output Analysis of Bond Graph-Based Dynamic Models in Simulink

Unit 4	**Modeling and Simulation of Vehicle Subsystems Using Simulink**	**15 hours**

Vehicle Dynamics overview- Lateral and Longitudinal dynamics, vehicle as a multi-body dynamic system, modeling longitudinal vehicle dynamics, Simulink model for vehicle acceleration/deceleration including acting forces, Vehicle subsystem to simulate- Braking system model, Engine and drivetrain system model using Simulink.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Simulation of Engine and Drivetrain Subsystem Dynamics in a Vehicle Using Simulink
- Braking System Simulation: Force Analysis and Vehicle Response Using Simulink
- Vehicle as a Multi-Body Dynamic System: Integrated Subsystem Modeling in Simulink

Unit 5	**Interpretation of Results**	**15 hours**

Interpreting the results derived of various Vehicle Models simulated using Simulink, Data Logging and Analysis, Hands on Experience, Results Presentation

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Data Logging and Performance Analysis of Vehicle Acceleration and Braking in Simulink
- Real-Time Data Monitoring and Logging for a Vehicle Suspension System in Simulink

	Total Lecture Hours	**75 hours**

Textbook:

1. W. J. Palm III, System Dynamics. New York, NY, USA: McGraw-Hill, 2005
2. D. C. Karnopp, D. L. Margolis, and R. C. Rosenberg, System Dynamics: Modeling, Simulation, and Control of Mechatronic Systems, 5th ed. Hoboken, NJ, USA: Wiley, 2012.

Reference Books:

1. W. J. Palm III, System Dynamics. New York, NY, USA: McGraw-Hill, 2005.
2. Tewari, Modern Control Design with MATLAB and Simulink. Hoboken, NJ, USA: Wiley, 2007.
3. K. Ogata, Modern Control Engineering, 5th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2009.
4. H. Klee and R. Allen, Simulation of Dynamic Systems with MATLAB and Simulink, 2nd ed. Boca Raton, FL, USA: CRC Press, 2011.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE207E	Course Name: Sensors & Automation Essentials	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

Aim to give exposure to the students about Sensors & Automation which are required in industry.

Course Outcome: After completion of the course, the student will be able to

1. Understand the PLC, Communication protocol role in industrial automation and role of IIOT gateways.
2. Understand the PLC panel electrical wiring on PLC Analog and digital cards.
3. Apply the Role of industrial gateways in IIOT.
4. Develop the real time application covering of IIOT.
5. Establish Communication between two industrial devices.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1 | Introduction Industrial Automation & IIOT | 15 hours

Types of Industrial Automation Factory & Process automation, Hierarchy involved Field to operating level, Internal structure of PLC (Internal electronics) and their IP ratings, Selection criteria of PLC, Communication protocol role in industrial automation, Role of IIOT gateways, PLC programming Languages, data types in PLC (real time application based Digital number system), practical application based on digital logic gates.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Study and Simulation of Industrial Automation Hierarchies: From Field Devices to Control Rooms
- Digital Logic Gate Implementation and Real-Time PLC Programming Using Ladder Logic

Unit 2 | Digital & Analog signal types in PLC | 15 hours

Pheonix PLC panel electrical wiring on PLC Analog and digital cards, covering how digital & analog signal processing with analog signal scaling with real time application (covering temperature & pressure transmitter). CAD and SLD drawing reading as per application.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Wiring and Testing of Phoenix PLC Digital and Analog I/O Cards for Real-Time Applications
- Analog Signal Conditioning and Processing: Interfacing with Phoenix PLC Analog Cards

Unit 3 | Communication protocols in IIOT | 15 hours

Role of industrial gateways in IIOT, discussing key protocols Modbus TCP-IP, RS-232, RS-485, Profinet Profibus, and web data sharing protocols like MQTT etc.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Experimenting with Modbus TCP/IP Communication via Industrial Gateways
- RS-485 to MQTT Data Transmission: A Hands-On Approach
- Integrating Profibus and Profinet Networks Using Industrial Gateways
- Cloud Data Sharing via MQTT: Real-Time Monitoring in IIoT
- RS-232 to Cloud Integration: Leveraging Industrial Gateways for IIoT

Unit 4	Sensor & Instrumentation Interfacing with PLC	15 hours

Sensor & Instrumentation Interfacing with PLCs, Sensor Signal Conditioning and Interfacing Techniques (Interfacing techniques (sink/source wiring, voltage/current input, relay outputs), Real-world applications: motor control, process automation.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Sensor and Instrumentation Interfacing with PLCs in Industrial Automation
- Signal Conditioning Techniques for Sensor Integration with PLCs
- Understanding Sink/Source Wiring and Voltage/Current Input in PLC Systems
- Motor Control Applications Using PLCs in Industrial Automation
- Real-World Process Automation: PLC-Based Control of Temperature, Pressure, and Flow

Unit 5	Application Development	15 hours

Developing real time application covering all above topics (like analog digital processing with analog signal scaling), Establishing communication between two industrial devices.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Developing a Real-Time PLC Application for Analog and Digital Signal Processing
- Establishing Communication Between Industrial Devices: A Real-Time PLC-Based System
- Analog Signal Scaling and Digital Processing in Real-Time Industrial Applications
- Designing a Real-Time Motor Control System Using PLCs and Sensor Integration
- Building a Real-Time Process Automation System with PLC Communication and Signal Conditioning

Total Lecture Hours	75 hours

Textbook:

1. V. Kumar, *Getting Started with S7-1200*. Siemens Automation, 2017.

Reference Books:

1. J. W. Webb and R. A. Reis, *Programmable Logic Controllers: Principles and Applications*, 5th ed. Upper Saddle River, NJ, USA: Prentice Hall, 2002.
2. R. Singh, *SCADA for Engineers*, New Delhi, India: KHANNA Publishing, 2016.
3. R. Srinivasan, *PLC and SCADA for Beginners*, Chennai, India: Technical Publications, 2020.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE203L	Course Name: Electrical Machine-II	L	T	P	C
		3	1	0	4

Pre-requisite: Knowledge of Basic Electrical Engineering and Engineering Mathematics.

Course Objectives:

Aim to explore various control methods for induction and synchronous machines, including speed control, synchronization, and parallel operation.

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate the constructional details and principle of operation of Synchronous Machine.
2. Analyze the performance of Synchronous Machine using the phasor diagrams and equivalent circuit.
3. Select appropriate 3-ϕ AC machine for any application and appraise its significance.
4. Start and observe the various characteristics of three phase Induction Machine.
5. Explain the principle of operation and performance of Single-Phase Induction Motor & Universal Motor.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Construction and Working of Synchronous Machine	09 hours

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, Voltage and frequency control (Governer system) of alternators, Parallel operation of synchronous generators, Operation on infinite bus, Synchronizing power and torque coefficient.

Unit 2	**Performance Analysis of Synchronous Machine**	**09 hours**

Two reaction theory, Transient and sub-transient reactance, 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.

Unit 3	**Construction and Working of Three Phase Induction Motor**	**09 hours**

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, principle of operation and application of induction generator.

Unit 4	**Starting Methods and Speed Control of Three Phase Induction Motor**	**09 hours**

Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed control (with and without emf injection in rotor circuit).

Unit 5	**Single Phase Induction Motor**	**09 hours**

Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, Repulsion motor, Universal motor.

	Theory Lecture Hours	**45 hours**

Textbook:

1. P S Bimbhra, "Electrical Machinery", Khanna Publisher.
2. I J Nagrath & D.P. Kothari, "Electrical Machines", McGraw Hill.
3. Irving Kosow, "Electric Machinery and Transformers", 2nd Edition.
4. Rajendra Prasad, "Electrical Machines", PHI Learning Pvt. Ltd.
5. AE Fitzgerald, C. Kingsley Jr and Umans, "Electric Machinery", McGraw Hill, International Student Edition.

Reference Books:

1. H. Cotton, "Electrical Technology", CBS Publication.
2. MG Say, "The Performance and Design of AC machines", Pitman& Sons.
3. PS Bimbhra, "Generalized Machine Theory".
4. Samarjit Ghosh, " Electrical Machines", Pearson Education.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE204L	**Course Name: Control Systems**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite: Knowledge of Physics, Mathematics, basic signal and systems and network systems

Course Objectives:

1. Aim to understand the different types of control systems and their application in practical life.
2. Aim to understand the concept of stability and its assessment for linear-time invariant systems in time domain and in frequency domain.

Course Outcome: After completion of the course, the student will be able to

1. Calculate the transfer function for the operation of open loop and closed loop control systems.
2. Analyze the performance of basic control systems in the time domain.
3. Analyze the stability of linear time-invariant systems in time domain using Routh Hurwitz criterion and root locus technique.
4. Analyze the stability of linear time-invariant systems in frequency domain using Nyquist criterion and Bode plot.
5. Understand the different types of compensators to achieve the desired performance of control System.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		-	-	-	-	-	-	-	1	-	3
CO2	3	2	-	2	2	-	-	-	-	1	-	3
CO3	3	2	-	2	3	-	-	-	-	1	-	3

CO4	3	2	-	2	3	-	-	-	-	1	-	3	
CO5	3	1	-	1	2	-	-	-	-	1		2	

Unit 1	**Control System Concepts**	**09 hours**

Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, Mathematical modelling of physical systems (Electro Mechanical), Determination of transfer function by block diagram reduction techniques and signal flow method using Mason's gain formula.

Unit 2	**Time Response Analysis and Basic modes of feedback control**	**09 hours**

Time Response Analysis: Standard test signals, time response analysis of first and second order systems, time response specifications of second order system for unit step input, location of roots of characteristics equation and corresponding time response, steady state errors and error constants,
Basic modes of feedback control: Proportional, Derivative, Integral and PID controllers.

Unit 3	**Stability Analysis in Time Domain**	**09 hours**

Stability and Algebraic Criteria: Concept of stability and its necessary conditions, Routh-Hurwitz criteria, and its limitations.
Root Locus Technique: Salient features of root locus plot, Procedure for plotting root locus, examples based on root locus.

Unit 4	**Stability Analysis in Frequency Domain**	**09 hours**

Frequency Response Analysis: Frequency Response analysis from transfer function model, Correlation between time and Frequency Responses, Construction of polar plot.
Stability in Frequency Domain: Nyquist stability criterion, Determination of gain and phase margin from Bode & Nyquist Plots.

Unit 5	**Compensation Techniques and State Space Analysis**	**09 hours**

Introduction to Design: The design problems and preliminary considerations of lead, lag and lead-lag compensation networks, design of compensation networks using time response and frequency response of the system.
State Space Technique: The concept of state & space, State-space model of physical system, conversion of state-space to transfer function model and vice-versa, State transition matrix, Concept of controllability and observability and their testing.

Total Lecture Hours	**45 hours**

Textbook:
1. J. Nagrath & M. Gopal, "Control System Engineering", 6th Ed. New Age International Publishers, 2018. 4th Edition.
2. Ogata, "Modern Control Engineering, 5th Edition", Pearson Education, 2015.
3. B.C. Kuo & Farid Gol Naraghi, "Automatic Control Systems", 10th Edition, McGraw Hill.
4. B.S. Manke, "Linear Control Systems", Khanna Publishers.

Reference Books:
1. Norman S. Mise, Control System Engineering, Wiley Publishing Co.
2. Varmah, "Control Systems", Mc Graw Hill Publication.
3. M. Gopal, "Control System Principles and Design", McGraw Hill 4th Edition.
4. S. Hasan Saeed, "Control Systems", S. K. Kataria & Sons.
5. Ashfaq Husain, Haroon Ashfaq, "Control Systems", Dhanpat Rai & Co.

Mode of Evaluation:

MSE		**CA**			**ESE**	**Total**
MSE1	**MSE2**	**CA1**	**CA2**	**CA3(ATT)**		
30	30	6	6	3	**75**	**150**
60		**15**				

Course Code: EE109L	**Course Name: Network Analysis and Synthesis**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Pre-requisite: Basic knowledge of Electrical Circuits and Ohm's Law, Fundamentals of AC and DC circuit analysis, Familiarity with Laplace Transform and Fourier transform.

Course Objectives:
Aim to understanding network topology and circuit analysis techniques.

Course Outcome: After completion of the course, the student will be able to
1. Understand the concepts of network topology using graphs, theory.
2. Apply various network theorems to analyze electrical networks.
3. Analyze transient response of electrical circuits using initial conditions and Laplace transforms.
4. Evaluate the performance of two-port networks using open circuit, short circuit, hybrid, and transmission parameters, including ladder and lattice networks.

5. Synthesize network functions by determining poles and zeros by using Hurwitz polynomials.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	**Network Topology**	**09 hours**

Classification of circuit elements, Concept of network graphs, tree, link, incidence matrix, cut set matrix, Tie set matrix, Isomorphism, Duality, Mesh and Nodal Analysis (AC & DC circuits), Magnetically coupled circuits.

Unit 2	**Network Theorems**	**09 hours**

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Substitution theorem, Reciprocity theorem. Milliman's theorem, Compensation theorem, Tellegen's Theorem.

Unit 3	**Transient Network Analysis**	**09 hours**

Types of time response analysis, Initial conditions in transient state, First order source free RC and RL circuits, time constant, Sourced series and parallel circuits, Second order circuits transient analysis, Transient analysis using Laplace transform.

Unit 4	**Two Port Networks**	**09 hours**

Open circuit parameters, short circuit parameters, hybrid and transmission parameters, Inter relations of two port network, Inter- connections of two port networks, Ladder and Lattice networks: T & Π representation, terminated two Port networks.

Unit 5	**Network Synthesis & Computer Aided Network Analysis**	**09 hours**

Poles and zeros of network functions, positive real functions and their properties, Hurwitz polynomials; Driving-point synthesis of LC, RC and RL networks, Foster form and Cauer form. Analysis of linear and non-linear networks, concept of companion network model; Computer aided transient network analysis.

	Theory Lecture Hours	**45 hours**

Textbook:

1. Van Valkenburg, M.E. – *Network Analysis*, Pearson Education.
2. Hayt, W.H., Kemmerly, J.E., & Durbin, S.M. – *Engineering Circuit Analysis*, McGraw-Hill Education.
3. Sudhakar, A., & Shyammohan S. Palli – *Circuits and Networks: Analysis and Synthesis*, McGraw-Hill Education.
4. Roy Choudhury, D. – *Networks and Systems*, New Age International Publishers.

Reference Books:

1. Desoer, C.A., & Kuh, E.S. – *Basic Circuit Theory*, McGraw-Hill Education.
2. Chakrabarti, A. – *Circuit Theory (Analysis and Synthesis)*, Dhanpat Rai & Co.
3. Ghosh, S. – *Network Theory: Analysis and Synthesis*, PHI Learning.
4. Smarajit Ghosh – *Network Theory*, PHI Learning.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE110L	**Course Name: Data Base and Applications**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Pre-requisite: Knowledge of Mathematics in Secondary Education.

Course Objectives:

1. Aim to understand the Fundamentals of Databases using SQL.
2. Aim to explore Advanced Database Concepts and Real-World Applications.

Course Outcome: After completion of the course, the student will be able to

1. Understand the basics of databases, their importance, and foundational concepts.,
2. Apply the SQL for data manipulation and retrieval.
3. Apply the advanced database features and management techniques.
4. Apply database knowledge to data analysis and engineering problems.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	-	-	-	-	-	-	2
CO2	3	2	2	2	3	-	-	-	-	-	-	3
CO3	3	2	2	2	3	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	-	3

Unit 1	**Introduction to Databases and Data Management**	**08 hours**

Introduction to Databases Database System Architecture, Data Models, ER Diagrams and Relationships, Relational Model Basics, File Organization and Storage, Database Development Lifecycle. Database Design Principles, Keys and Constraints, Introduction to Normalization & Denormalization.

Unit 2	**SQL and Query Processing**	**08 hours**

Introduction to SQL, SQL Queries – Basic Operations, SQL Joins, Aggregate Functions and Grouping, Subqueries and Nested Queries, Database Modification, Query Optimization Basic

Unit 3	**Advanced Database Concepts and Management**	**07 hours**

Transactions and Concurrency- ACID properties, Concurrency control (locking, timestamping)
Database Security, Backup and Recovery, Introduction to NoSQL Databases, Distributed Databases, Database Administration

Unit 4	**Data Analysis and Applications**	**07 hours**

Introduction to Data Analysis, SQL for Data Analysis, Data Visualization Basics, Big Data and Databases, Real-World Applications

	Total Lecture Hours	**30 hours**

Textbook:

1. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 7th ed. New York, NY, USA: McGraw-Hill, 2020.
2. R. Elmasri and S. B. Navathe, *Fundamentals of Database Systems*, 7th ed. Boston, MA, USA: Pearson, 2016.
3. J. A. Hoffer, H. Topi, and R. Venkataraman, *Modern Database Management*, 14th ed. Boston, MA, USA: Pearson, 2020.
4. C. J. Date, *An Introduction to Database Systems*, 8th ed. Boston, MA, USA: Pearson, 2003.

Reference Books:

1. R. M. P. Teate, *SQL for Data Scientists: A Beginner's Guide for Building Datasets for Analysis*. Hoboken, NJ, USA: Wiley, 2021.
2. M. J. Hernandez, *Database Design for Mere Mortals: A Hands-On Guide to Relational Database Design*, 3rd ed. Boston, MA, USA: Addison-Wesley, 2013.
3. M. Winand, *SQL Performance Explained*. Self-published, 2012.
4. P. J. Sadalage and M. Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. Boston, MA, USA: Addison-Wesley, 2012.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
20	20	4	4	2	50	100
40		10				

Course Code: HS112L	**Course Name: Universal Human Values**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite: NA

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content, and process of value education.
2. To help students initiate a process of dialog within themselves to know what they really want to be in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

Course Outcome: After completion of the course, the student will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content, and process of value education, explore the meaning of happiness and prosperity, and do a correct appraisal of the current scenario in the society.
2. Distinguish between the Self and the Body, and understand the meaning of Harmony in the Self and the Co-existence of Self and Body.
3. Understand the value of harmonious relationships based on trust, respect, and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society.
4. Understand the harmony in nature and existence, and workout their mutually fulfilling participation in nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Introduction to Value Education	10 hours

Understanding the need, basic guidelines, content, and process for Value Education, Self- Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation –as the mechanism for self-exploration, Continuous Happiness, and Prosperity-A look at basic Human Aspirations, Right understanding, Relationship, and Physical Facilities-the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Unit 2	Understanding Harmony in the Human Being	10 hours

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer, and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

Unit 3	Understanding Harmony in the Family and Society	10 hours

Harmony in Human-Human Relationship Understanding harmony in the Family-the basic unit of human interaction, Understanding values in the human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect(Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in a relationship, Understanding the harmony in the society (society being an extension of the family): Samadhan, Samridhi, Abhay, Sah- astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) – from family to world family!

Unit 4	Understanding Harmony in Nature and Existence	09 hours

Whole existence as Co-existence Understanding the harmony in Nature, Inter connectedness, and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.

Unit 5	Implications of the above Holistic Understanding of Harmony on Professional Ethics	06 hours

Natural acceptance of human values, Definiteness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics.

	Total Lecture Hours	45 hours

Textbook:

1. R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course in Human Values and Professional Ethics. ISBN 978-93-87034-47-1, Excel Books, New Delhi.

Reference Books:

1. Ivan Illich, Energy & Equity, The Trinity Press, Worcester and Harper Collins, USA,1974.
2. E.F. Schumacher, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain,1973.
3. A Nagraj, Jeevan Vidya EkParichay, Divya Path Sansthan, Amarkantak 1998.
4. P L Dhar, RR Gaur, Science and Humanism, Commonwealth Publishers 1990.

Mode of Evaluation

MSE		CA			ESE	Total	
MSE1	MSE2	CA1	CA2	CA3 (ATT)			

30	30	6	6	3			
60		15			75	150	

Course Code: HS113L	Course Name: Aptitude-2	L	T	P	C
		1	0	0	1

Pre-requisite: NA

Course Objectives:

1. To provide adequate exposure to the students regarding the use of aptitude tests in the recruitment process and competitive examinations.
2. To improve the logical & numerical ability of the students.

Course Outcome: After completion of the course, the student will be able to

1. Illustrate their comprehension by solving the given problems
2. Apply the learned concepts to new problems and solve them aptly.
3. Make use of their thought process to interpret and draw inferences from the given data to reach logical conclusions.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	1	-	1	-	-	-	-	-	1
CO2	1	1	-	1	-	2	-	-	-	-	-	1
CO3	1	1	-	1	-	1	-	-	-	-	-	2

Unit 1	Analytical Reasoning & Logical Puzzles	04 hours

Definition and Introduction of Concept and Relation of Cube and Cuboids, Cut the cube in different layer and then solve questions accordingly. Problems related with open and closed dice.

Unit 2	Syllogism	03 hours

Understanding of Venn diagram, Problems related with Venn diagram, Statement and Conclusion, Syllogism and reverse syllogism.

Unit 3	Clock and Calendar	04 hours

Definition and Introduction of Concept and Relation of angle and time, Overtaking, overlapping, right-angle and straight Angle with respect to time, Error in clock (faster and slower), Correct time of clock, Mirror and Water Image of clock, Introduction of Calendar, Concept of Normal and Leap Year, Finding Odd days, Finding the day of the week of given date with and without reference.

Unit 4	Data Interpretation and Critical Reasoning	04 hours

Tables (Understand of Table, Fillers in table), **Line Graph** (Understand the graph, Percentage change, Ratio based comparison), **Bar Graph** (Type of Bar Graph, Average and Comparison, Stacked Bar Graph), **Pi Chart** (Conversion of Percentage and Degree, Fillers in Pie chart, Multiple Pie chart), **Mixed Graph (problems** related with combination of various charts**) Critical Reasoning**: Assumptions, Cause and Effect, Assertion and Reason, Statement and Inference

Total Lecture Hours	15 hours

Useful resources:

1. **"**A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal, S. Chand Publication.
2. https://www.geeksforgeeks.org/most-important-aptitude-topics-for-placements/

Reference Books:

1. "How to Prepare for Logical Reasoning for the CAT" by Arun Sharma, TMH Publication.
2. https://www.indiabix.com/logical-reasoning/questions-and-answers/
3. https://testbook.com/placement-aptitude/test-series

Mode of Evaluation

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3 (ATT)		
-	-	10	10	5		
-		25			25	50

Course Code: HS114L	Course Name: Soft Skills Essentials 2	L	T	P	C
		1	0	0	NC

Pre-requisite:

- Successful completion of the subject 'Soft Skills Essentials-1' of the third semester.

Course Objectives:

To strengthen students' professional communication, cultural intelligence, and emotional awareness through advanced speaking activities, scenario-based discussions, and digital literacy tasks, equipping them for diverse workplace interactions.

Course Outcome: After completion of the course, the student will be able to

1. Apply advanced communication strategies that include vocabulary enhancement, storytelling to improve their cultural sensitivity (DEI).
2. Demonstrate prompt writing for AI-based tools and create effective elevator pitches to convey ideas with clarity and impact.
3. Exhibit interpersonal effectiveness by navigating negotiation, persuasion, and emotional intelligence in professional contexts

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	-	-	1	3	-	2
CO2	-	-	-	-	-	-	-	-	1	3	-	2
CO3	-	-	-	-	-	1	-	-	1	3	-	2

Unit 1	Advanced Communication and Cultural Sensitivity	7 hours

Vocabulary Enhancement through Gamification, Story Coining and Presentations Understanding Cross-Cultural, Communication (DEI) using Case Studies, Duo Lingo English Proficiency Tests

Unit 2	Professional Expression and Digital Literacy	4 hours

TMAY through Driver's test, Writing Effective Prompts on Various LLMs, Duo Lingo English Proficiency Tests

Unit 3	Interpersonal Effectiveness and Emotional Intelligence	4 hours

Negotiation & Persuasion Role Plays, Developing Emotional Intelligence via Scenario-Based Discussions

Total Lecture Hours	15 hours

Useful Resources:

1. https://youtu.be/5Wr-uaGzY7c
2. https://youtu.be/NcCwlqBapHo
3. https://youtu.be/SKNmQPIBPIg
4. RAISEC - B. Tech. MCA - Introduction
5. RAISEC - B. Tech. MCA - Social Personality Type
6. RAISEC - B. Tech. MCA - Enterprising Personality Type
7. RAISEC - B. Tech. MCA - Conventional Personality Type

Mode of Evaluation

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3		
-	-	10	10	5		
-		25			25	-

Course Code: EL207E	Course Name: AI and Machine Learning for Smart Grids	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

1. To introduce AI/ML fundamentals and their relevance in power systems and smart grids.
2. To develop skills for data acquisition, preprocessing, and analytics in smart grid scenarios.
3. To model and implement AI/ML solutions for load forecasting, fault detection, and demand-side management.
4. To expose students to industry-standard case studies, tools, and Tata Power-DDL's real-world implementations.

Course Outcome: After completion of the course, the student will be able to

1. Understand and interpret the role of AI/ML in the evolution of smart grid systems.
2. Apply ML models for load forecasting, anomaly detection, and predictive analytics in power networks.
3. Implement AI/ML algorithms using Python and MATLAB on real-world or simulated smart grid datasets.
4. Evaluate AI/ML-based smart grid case studies, especially from Tata Power-DDL, and suggest improvements.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	Introduction to AI and ML in Smart Grids	19 hours

Smart Grid recap (digitization, two-way communication, IoT, and DERs), AI/ML in power systems, Supervised vs Unsupervised learning; Overview of common models (LR, SVM, k-NN, Decision Trees, ANN), Smart grid data ecosystem: types, sources, and formats.

Activities:

- Import and explore power system datasets using Pandas and Matplotlib
- Simulate time-series power data and visualize trends using SCADA/Excel.

Unit 2	Load Forecasting using ML Techniques	19 hours

Short-term, medium-term, and long-term load forecasting, Regression models (Linear Regression, Ridge, Lasso), Neural Networks and LSTM models for time-series forecasting, Evaluation metrics (RMSE, MAPE, R^2)

Activities:

- Build and train a linear regression model to forecast daily load
- Implement LSTM-based load prediction using Keras/TensorFlow.

Unit 3	Fault Detection and Predictive Maintenance	19 hours

Nature of faults in transmission/distribution systems, Signal processing and feature extraction (FFT, DWT), Classification algorithms (SVM, Random Forest, CNN for fault identification), Predictive maintenance using anomaly detection and clustering (k-Means, DBSCAN)

Activities:

- Analyze voltage/current signal datasets using FFT in MATLAB
- Train a classifier for fault detection using SVM in Python.

Unit 4	Demand Response and Optimization using AI	18 hours

Demand response (DR) basics (TOU pricing, dynamic pricing, peak shaving), Optimization techniques (Genetic Algorithms, Reinforcement Learning), Consumer behavior prediction using unsupervised learning, Load disaggregation and demand-side flexibility.

Activities:

- Implement simple DR strategies using pricing signals in Python
- Simulate RL-based load control policy using OpenAI Gym.

	Total Lecture Hours	75 hours

Textbook:

1. Elissaios Sarmas et al., Artificial Intelligence for Energy Systems, Springer
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.

Reference Books:

1. Tata Power-DDL Technical Reports, Whitepapers
2. IEEE Transactions on Smart Grid
3. GitHub Repositories for Power System AI Projects
4. Online datasets: Kaggle, UCI ML Repository, OpenEI.

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE206E	Course Name: Integration of Systems of EVs	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:

Aim to equip the students with the skills to understand the system level architecture and integration of EV systems

Course Outcome: After completion of the course, the student will be able to

1. Identify key components and subsystems of an Electric Vehicle (EV), including the battery, motor, inverter, VCU, and charger.
2. Explain the functional role and interaction of EV subsystems such as battery packs, motors, controllers, and communication protocols.
3. Analyze EV powertrain performance and control architecture using software tools like ADVISOR, MATLAB, and CANalyzer.
4. Evaluate trade-offs in battery chemistry, BMS topologies, and subsystem integration choices based on functional and efficiency criteria.
5. Design a simplified EV subsystem integration framework using hardware-software interfacing, communication protocols, and control logic.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1	**EV Systems Architecture and Requirements**	**15 hours**

Overview of EV systems and subsystems, Electric Vehicles in India, Forces acting when a vehicle move, Power and Torque calculations, Concept of Drive Cycle- Indian Drive Cycle and associated calculations, EV subsystem – Design of EV drive train.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Case Study of Forces acting on a Nissan Magnite
- Indian Drive Cycle – Excel Sheet Calculation to various drive scenarios.

Unit 2	**Battery and Powertrain Subsystems Integration**	**15 hours**

Introduction to batteries parameters, Cells and Batteries, Lithium-ion battery and Sodium Ion battery- Terminologies and Working, Parameters for selecting the cell chemistry, cell form factors, Parameters for designing battery pack configuration, Battery Management System, BMS Topology – Centralized, Master and Slave, Modular and Distributed, Introduction to Electric Powertrain.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- ADVISOR Tool Demonstration and conclusion.
- Case Study of White Paper – How Cells are Manufactured.
- Understanding Cell Data Sheet
- EV Database Website Demonstration

Unit 3	**Electric Powertrain**	**15 hours**

Components of an Electric Powertrain: Electric motors, Power electronics, Battery systems, Understanding Requirements from EV powertrain- Vehicle Load forces, Power, Energy and Speed relationships, Aerodynamic Drag, Rolling Resistance and Gradeability, Example- Tesla Model S (2013) and E-Rickshaw power demand Calculations, Battery Electric Vehicle Range at Constant Speed, Vehicle Acceleration- Traction Motor Characteristics, 2015 Nissan Leaf Rated Speed, Simplified Traction Machine Torque-Speed Characteristic (MATLAB Script Code)

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Case Study of Force calculations of Nissan Micra
- Simplified Machine Torque-Speed Characteristics of a Motor (MatLaB Script Code Demonstration)

Unit 4	**Fundamental of Control System Integration**	**15 hours**

Microprocessor Architecture: Internal architecture of microprocessors, Key components: ALU, registers, control unit, Memory Interfacing: Addressing schemes and memory organization, Interfacing with RAM and ROM in automotive applications, Input/Output Interfacing: Basics of I/O interfacing, 8086 and 8087 microprocessors

Hands-on/Case Study/ Mini-Project/ Problem solving:

- CANalyzer – Case Study

Unit 5	**Communication Protocols**	**15 hours**

Controller Area Network (CAN) Protocol: Basics of the CAN protocol, Message format, Bus Arbitration, CAN in-vehicle networking for communication between ECUs, LIN (Local Interconnect Network) and Flex Ray-Overview of LIN and Flex Ray protocols, Applications and advantages in automotive systems-LIN in Interior Lighting control, FlexRay in Advanced Driver Assistance Systems (ADAS)

Hands-on/Case Study/ Mini-Project/ Problem solving:

- CAN Cable Demonstration

	Total Lecture Hours	**75 hours**

Textbook:
1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles by Mehrdad Ehsani, Yimin Gao, Ali Emadi, Crc Press
2. The 8051 Microcontrollers: Architecture, Programming and Applications By Kenneth J Ayala, Cengage India Private Limited

Reference Books:
1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles by Mehrdad Ehsani, Yimin Gao, Ali Emadi, Crc Press

Mode of Evaluation:

MSE		CA			ESE	Total
MSE1	MSE2	CA1	CA2	CA3(ATT)		
40	40	8	8	4	100	200
80		20				

Course Code: EE208E	Course Name: Integration of SCADA and PLC with IIOT Gateways	L	T	P	C
		3	0	2	4

Pre-requisite: NA

Course Objectives:
Aim to give exposure to the students about Sensors & Automation which are required in industry.

Course Outcome: After completion of the course, the student will be able to
1. Understand the types of SCADA and Data sharing between PLC.
2. Understand the Real-time Data Analytics in SCADA Systems using IIoT Edge Devices.
3. Apply the IIoT-Enabled Data Interfacing for ERP Systems.
4. Apply the data types involved in PLC & IIOT Gateway
5. Develop the real time application covering of IIOT.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

Unit 1 | Introduction SCADA | 15 hours

Introduction to SCADA, SCADA software types, Tags concepts of SCADA, SCADA programming along with report generation using VB scripting. Data sharing between PLC and SCADA software.

Hands-on/Case Study/ Mini-Project/ Problem solving:
- SCADA Programming and Simulated Report Generation using VB Scripting
- Simulated Data Exchange Between Virtual PLC and SCADA

Unit 2 | Real-time Data Analytics in SCADA Systems using IIoT Edge Devices | 15 hours

Designing a hybrid SCADA-IIOT architecture, Real-time Data Analytics Techniques, how edge devices communicate with SCADA and cloud., Data formats (JSON, XML).

Hands-on/Case Study/ Mini-Project/ Problem solving:
- Design and Simulation of a Hybrid SCADA-IIoT Architecture
- Implementation of Cloud Connectivity in SCADA via IoT Gateways
- Data Format Handling and Parsing: JSON vs XML in IIoT Applications
- Edge Device Communication with SCADA and Cloud via MQTT Protocol

Unit 3 | IIoT-Enabled Data Interfacing for ERP Systems | 15 hours

Architecture overview: Edge device → Gateway → ERP system (How data moves from sensors/machines to ERP via IIoT gateways), Types of data shared (e.g., machine status, production metrics, energy consumption)., Benefits of energy monitoring system.

Hands-on/Case Study/ Mini-Project/ Problem solving:
- Simulating Edge-to-ERP Data Flow in a SCADA-IIoT Architecture
- Role and Simulation of IIoT Gateways in Industrial Communication
- Design and Simulation of an Energy Monitoring System

Unit 4 | Data Types involved in PLC & IIOT Gateway | 15 hours

Boolean (Binary Data), Integer, Float / Real, String (Device names, status messages, error codes, configuration parameters), Date Time / Timestamp.

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Handling Boolean (Binary) Data for Machine Status and Control
- Transmission and Logging of Integer and Float Data in SCADA-IIoT
- Using Strings in SCADA for Device Identification and Messaging

Unit 5	**Application Development**	**15 hours**

Developing real time application covering all above topics (Edge device → Gateway → ERP system)

Hands-on/Case Study/ Mini-Project/ Problem solving:

- Real-Time Data Analytics and Visualization using Dashboards
- Simulation of Edge Device Data Generation Using Multiple Data Types
- Simulating Data Exchange from Gateway to ERP System

	Total Lecture Hours	**75 hours**

Textbook:

1. S. K. Singh, *Industrial Automation and Control*. New Delhi, India: McGraw Hill, 2016.
2. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, *Industrial Internet of Things: Cyber manufacturing Systems*. Cham, Switzerland: Springer, 2017.

Reference Books:

1. S. G. McCrady, *Designing SCADA Application with VB and Database*. Oxford, UK: Elsevier, 2006.
2. R. Buyya and A. V. Dastjerdi, *Internet of Things: Principles and Paradigms*. Cambridge, MA, USA: Morgan Kaufmann, 2016.
3. S. A. Boyer, *SCADA: Supervisory Control and Data Acquisition*, 4th ed. Durham, NC, USA: ISA, 2009.
4. T. Winters, *Practical Industrial Internet of Things (IIoT): A Guide to Smart Manufacturing and Industry 4.0*. Birmingham, UK: Packt Publishing, 2020.

Mode of Evaluation:

MSE		**CA**			**ESE**	**Total**
MSE1	**MSE2**	**CA1**	**CA2**	**CA3(ATT)**		
40	40	8	8	4	**100**	**200**
80		**20**				

Practical Courses Detail Syllabus

Course Code: EE203P	Course Name: Electrical Machine-II Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

Aim to explore various control methods for induction and synchronous machines, including speed control, synchronization, and parallel operation.

Course Outcome: After completion of the course, the student will be able to

1. Perform various tests and demonstrate the various characteristics of 3-ϕ induction motor.
2. Demonstrate the working of three phase synchronous machine under different operating conditions.
3. Evaluate the performance of single-phase induction motor under different operating conditions.
4. Develop simulation models for Electrical Machines.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	2
CO2	3	2	2	2	-	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	-	3
CO4	3	3	2	2	-	-	-	-	-	-	-	3

List of Practical's (Indicative & not limited to)

1. To perform no load and blocked rotor tests on a 3-ϕ squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a 3-ϕ induction motor and draw Torque -speed characteristics.
3. To perform no load and blocked rotor tests on a 1-ϕ induction motor and determine equivalent circuit.
4. To study speed control of 3-ϕ induction motor by varying supply voltage and by keeping V/f ratio constant.
5. To perform open circuit and short circuit tests on a 3-ϕ alternator.
6. To determine V-curves and inverted V-curves of a three phase synchronous motor.
7. To determine the direct axis reactance (Xd) and quadrature axis reactance (Xq) of synchronous machine.
8. To study synchronization of an alternator with the infinite bus by using: (i) dark lamp method (ii) two bright and one dark lamp method.
9. To determine speed-torque characteristics of 3-ϕ slip ring induction motor and study the effect of including resistance, or capacitance in the rotor circuit.
10. To determine speed-torque characteristics of 1-ϕ induction motor and study the effect of voltage variation.
11. To determine speed-torque characteristics of a 3-ϕ induction motor by (i) keeping v/f ratio constant (ii) increasing frequency at the rated voltage.
12. To draw O.C. and S.C. characteristics of a 3-ϕ alternator from the experimental data and determine voltage regulation at full load, and unity, 0.8 lagging and leading power factors.
13. To determine steady state performance of a 3-ϕ induction motor using equivalent circuit.

Total Hours	30 hours

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	**25**	**50**

Course Code: EE204P	Course Name: Control Systems Lab	L	T	P	C
		0	0	2	1

Pre-requisite: Basic Electrical Engineering, Differential Equations, Linear Algebra, Signals & Systems

Course Objectives:

1. Aim to understand the different types of control systems and their application in practical life.
2. Aim to understand the concept of stability and its assessment for linear-time invariant systems in time domain and in frequency domain.

Course Outcome: After completion of the course, the student will be able to

1. Calculate the transfer function for the operation of open loop and closed loop control systems.
2. Analyze the performance of basic control systems in the time domain.

3. Analyze the stability of linear time-invariant systems in time domain using Routh Hurwitz criterion and root locus technique.
4. Analyze the stability of linear time-invariant systems in frequency domain using Nyquist criterion and Bode plot.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	-	-	2	2	2
CO2	2	2	2	2	2	2	2	-	-	2	2	2
CO3	2	2	2	2	2	2	2	-	-	2	2	2
CO4	2	2	2	2	2	2	2	-	-	2	2	2

List of Practical's (Indicative & not limited to)

1. To determine speed-torque characteristics of an AC servomotor.
2. To study
   a) Synchro Transmitter characteristics.
   b) Obtain Synchro Transmitter – Receiver output vs input characteristics.
3. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
4. To study characteristics of positional error detector by angular displacement of two servo potentiometers.
5. To simulate and compare the response of 2nd order system with and without lead, lag, Lead- Lag compensator / simulate PID controller for transportation lag.
6. To study P, PI and PID temperature controller for an oven and compare their characteristics.
7. To study performance of servo voltage stabilizer at various loads using load bank.
8. To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.

Software based experiments (Scilab/MATLAB or any equivalent open-source software**)**

1. To determine time domain response of a second order system for step input and obtain performance parameters.
2. To convert transfer function of a system into state space form and vice-versa.
3. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
4. To plot a Bode diagram of an open loop transfer function.
5. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

Total Hours	**30 hours**

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	**25**	**50**

Course Code: EE109P	Course Name: Network Analysis and Synthesis Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

Aim to understanding network topology and circuit analysis techniques.

Course Outcome: After completion of the course, the student will be able to

1. Apply network theorems to simplify complex circuits.
2. Analyze resonance in RLC circuits and calculate key parameters.
3. Determine and verify two-port network parameters and interconnections.
4. Design and analyze the behavior of filters and transient response of circuits.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	2	2	3	-	-	-	-	-	-	-	-	2
CO3	3	2	3	-	-	-	-	-	-	-	-	3
CO4	2	3	3	-	-	-	-	-	-	-	-	3

List of Practical's (Indicative & not limited to)

1. Verification of Maximum Power Transfer Theorem
2. Verification of Tellegen's Theorem
3. Study of Phenomenon of Resonance in RLC Series Circuit
4. Transient Response of RL Circuit
5. Determination of Two-Port Network Z and h Parameters
6. Verification of Parameters in Series-Series Interconnection of Two-Port Networks
7. Verification of Parameters in Parallel-Parallel Interconnection of Two-Port Networks
8. Determination of Z Parameters of a T Network and Computation of Corresponding Parameters to Equivalent π Network
9. Determination of Y and ABCD Parameters of a Two-Port Network
10. Verification of Parameters in Cascade Interconnection of Two-Port Networks

Total Hours | **30 hours**

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	**25**	**50**

Course Code: EE110P	**Course Name: Data Base and Applications Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Pre-requisite: Knowledge of Mathematics in Secondary Education

Course Objectives:

1. Aim to understand the Fundamentals of Databases using SQL.
2. Aim to explore Advanced Database Concepts and Real-World Applications.

Course Outcome: After completion of the course, the student will be able to

1. Understand the basics of databases, their importance, and foundational concepts.,
2. Master SQL for data manipulation and retrieval.
3. Explore advanced database features and management techniques.
4. Apply database knowledge to data analysis and engineering problems.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	-	-	-	-	-	-	2
CO2	3	2	2	2	3	-	-	-	-	-	-	3
CO3	3	2	2	2	3	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	-	3

List of Practical's (Indicative & not limited to)

1. Database Design and Schema Creation: Focuses on creating databases and defining relationships.
2. Basic SQL Operations: Covers fundamental SQL operations for data manipulation.
3. Keys and Constraints: Explores the use of keys and constraints to enforce data integrity.
4. Normalization and Denormalization: Deals with structuring data to eliminate redundancy and optimize performance.
5. Advanced SQL Queries: Involves writing complex queries with joins, subqueries, and aggregations.
6. Data Analysis with SQL: Focuses on analyzing data using SQL for insights.
7. Performance Optimization: Covers techniques to improve database performance.
8. Transactions and Concurrency: Manages transactions and resolves concurrency issues.
9. NoSQL and Big Data: Explores NoSQL databases and big data frameworks.
10. Application-Specific Databases and Visualization: Designs databases for specific applications and visualizes data.

Total Hours | **30 hours**

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	**25**	**50**

Course Code: EE107P	Course Name: Electrical Measurements and Data Acquisition Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

1. The course aims to provide knowledge and analytical skills for understanding and applying DC and AC bridge circuits to accurately and precisely measure electrical parameters.
2. It aims to train students to develop, implement, and apply data acquisition systems using hardware and software tools.

Course Outcome: After completion of the course, the student will be able to

1. Understand the principles and components of electrical measurement systems.
2. Understand bridge circuits for precise measurement and error evaluation.
3. Apply methods to measure voltage, current, power, energy, and power factor.
4. Apply data acquisition systems using MATLAB and Arduino in practical applications.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

List of Practical's (Indicative & not limited to)

1. To measure an unknown resistance using the Wheatstone bridge and verify the balance condition.
2. To measure low resistance accurately using the Kelvin Double Bridge and eliminate the effect of lead and contact resistances.
3. To determine the value of inductance using Anderson's Bridge and validate it through theoretical calculations.
4. To measure the capacitance and dissipation factor of a capacitor using the Schering Bridge.
5. To determine the frequency of an AC signal using the Wien Bridge and analyze the balance condition.
6. To acquire real-time voltage data through a voltage sensor interfaced with an NI USB-6009 DAQ card in LabVIEW.
7. To acquire real-time current data through a current sensor interfaced with an NI USB-6009 DAQ card in LabVIEW.
8. To determine the power consumed by a balanced three-phase load using the three-wattmeter method.
9. To measure the power factor of a load using a power factor meter and study the effect of different types of loads.
10. To interface a sensor (Temperature or LDR) with NI DAQ for analog signal data acquisition, and real-time monitoring.

Total Hours	30 hours

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	25	50

Course Code: EE202P	Course Name: Electrical Machine-I Lab	L	T	P	C
		0	0	2	1

Pre-requisite: NA

Course Objectives:

Aim to enable the students to analyze, design, and troubleshoot issues related to DC machines and transformers through numerical problems and laboratory experiments.

Course Outcome: After completion of the course, the student will be able to

1. Analyze and conduct basic tests on DC Machines and single-phase Transformer.
2. Obtain the performance indices using standard analytical as well as graphical methods.
3. Determine the magnetization, Load and speed-torque characteristics of DC Machines.
4. Demonstrate procedures and analysis techniques to perform electromagnetic and electromechanical tests on electrical machines.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	2
CO2	3	2	2	2	-	-	-	-	-	-	-	2

CO3	3	3	2	2	-	-	-	-	-	-	-	3	
CO4	3	3	2	2	-	-	-	-	-	-	-	3	

List of Practical's (Indicative & not limited to)

1. To obtain magnetization characteristics of a DC shunt generator.
2. To obtain load characteristics of a DC shunt generator and compound generator (a) Cumulatively compounded (b) Differentially compounded.
3. To obtain efficiency of a DC shunt machine using Swinburne's test.
4. To perform Hopkinson's test and determine losses and efficiency of DC machine.
5. To draw speed- torque characteristics of a DC shunt motor.
6. To obtain speed control of DC shunt motor using (a) armature resistance control (b) field control
7. To obtain speed control of DC separately excited motor using Ward-Leonard.
8. To obtain equivalent circuit, efficiency and voltage regulation of a single-phase transformer using O.C. and S.C. tests.
9. To obtain efficiency and voltage regulation of a single-phase transformer by Sumpner's test.
10. To obtain 3-ϕ to 2-ϕ conversion by Scott connection.
11. To demonstrate the parallel operation of three phase transformer and to obtain the load sharing at a load.

Total Hours | **30 hours**

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	25	50

Course Code: EE108P	**Course Name: Analog Electronics Lab**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Pre-requisite: Basic Electronics Engineering

Course Objectives:

Aim to design different types of amplifiers and oscillators.

Course Outcome: After completion of the course, the student will be able to

1. Explain the working and characteristics of semiconductor devices like diodes, BJTs, and FETs.
2. Analyze and design rectifiers, amplifiers, and oscillators using semiconductor devices.
3. Apply operational amplifiers in various linear and nonlinear applications.
4. Analyze and design feedback amplifiers, oscillators and multivibrator.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

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

List of Practical's (Indicative & not limited to)

1. Analyze cut-in voltage of PN Junction Diode and Break down voltage of Zener Diode.
2. Implement Half-Wave and Full-Wave Rectifiers with and without filters
3. Measure and analyze input and output characteristics of BJT in CE, CB, and CC configurations
4. Analyze Frequency Response of a BJT amplifier.
5. Implement FET as an amplifier and a switch.
6. Measure and Analyze Op-Amp characteristics (offset voltage, CMRR, Slew Rate)
7. Design and test Summing, Differentiator and Integrator Circuits.
8. Implement RC Phase Shift Oscillator and Wien Bridge Oscillator.
9. Generate and Analyze square waveforms using Schmitt Trigger.
10. Generate and Analyze Triangular waveforms using op-amp.

Total Hours | **30 hours**

Mode of Evaluation:

CA		ESE	Total
CA1	CA2		
12	13	25	50