National Institute of Technology Meghalaya

UG Curriculum with effect from AY 2024-25

In view of NEP2020

DEPARTMENT OF ELECTRICAL ENGINEERING

B.Tech - Electrical and Electronics Engineering

Abbreviations

SC	:	Science Core
ESA	:	Engineering Science & Arts
DSC	:	Dept. Specific Core
DSE	:	Dept. Specific Elective
OE	:	Open Elective
AECC	:	Ability Enhancement Compulsory Course
SECC	:	Skill Enhancement Compulsory Course
VAC	:	Value Added Course
L	:	Laboratory Course
A	:	Audit Course

1st Year Common Structure

Semester Wise Model Plan – First Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Science Core							
MA101	Engineering Maths-I	SC	3	1	0	4	None
CB101/PH101	Engineering Chemistry/ Engineering Physics	SC	3	0	0	3	None
CB151/PH151	Engineering Chemistry/Engineering Physics Lab	SC (L)	0	0	2	1	None
CB103	Biology for Engineers	SC	2	0	0	2	None
Engineering Science and Arts							
ME101	Engineering Mechanics	ESA	3	1	0	4	None
CS101	Computer Coding	ESA	2	0	0	2	None
CS151	Computer Coding Lab	ESA (L)	0	0	2	1	None
CE101	Engineering Graphics	ESA (L)	0	1	3	2	None
Skill Enhancement Compulsory Course							
HS151	Communication Skills	SECC(L)	0	1	2	2	None
Value Added Course							
VA101	NSS/NCC	VAC (A)	0	0	--	0	None
Total Contact Hours – Component wise			13	4	9		-
Total Contact Hours			26			21	-

Semester Wise Model Plan – Second Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Science Core							
MA102	Engineering Maths-II	SC	3	1	0	4	None
PH101/CB101	Engineering Physics/Engineering Chemistry	SC	3	0	0	3	None
PH151/CB151	Engineering Physics/Engineering Chemistry Lab	SC (L)	0	0	2	1	None
Engineering Science and Arts							
CB102	Environmental Science	ESA	2	0	0	2	None
EE102	Basic Electrical & Electronics Engineering	ESA	3	0	0	3	None
EE152	Basic Electrical & Electronics Engineering Lab	ESA (L)	0	0	2	1	None
ME152	Workshop Practice	ESA (L)	0	0	3	1	None
Skill Enhancement Compulsory Course							
HS102	Creativity, Innovation and Entrepreneurship	SECC	2	0	0	2	None
Ability Enhancement Compulsory Course							
CS152	Python Programming	AECC (L)	0	1	2	2	None
Value Added Course							
HS104	Ethics and Morals	VAC	2	0	0	2	None
VA102	Skill Development & Prototyping	VAC (L)	0	0	2	1	None
VA104	NSS/NCC	VAC (A)	0	0	--	0	None
Total Contact Hours – Component wise			15	2	11		-
Total Contact Hours			28			22	-

Semester Wise Model Plan – Third Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Department Specific Core							
EE201	Electrical Machines-I	DSC	3	0	0	3	None
EE203	Network Analysis	DSC	3	0	0	3	None
EE205	Electrical and Electronic Measurements	DSC	3	0	0	3	None
EE207	Analog Electronic Circuits	DSC	3	0	0	3	None
Department Specific Elective							
EE211 EE213 EE215 EE217 EE219	Electrical Wiring and Earthing Electromagnetic Field Theory Electronic Devices and Circuits Microprocessor and Interfacing Database Management System	DSE	3	0	0	3	None
Open Elective							
EE271	Renewable Energy Technology	OE	2	0	0	2	None
Value Added course/ Dissertation							
EE281	Electrical Safety and Standards	VAC	2	0	0	2	None
Laboratory							
EE251	Electrical Machines-I Lab	L	0	0	2	1	None
EE253	Network Analysis Lab	L	0	0	2	1	None
EE255	Electrical and Electronic Measurements Lab	L	0	0	2	1	None
Total Contact Hours – Component wise			19	0	6		-
Total Contact Hours			25			22	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fourth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Department Specific Core							
EE202	Electrical Machines-II	DSC	3	0	0	3	None
EE204	Power Systems-I	DSC	3	0	0	3	None
EE206	Signals and Systems	DSC	3	0	0	3	None
EE208	Digital Circuit Design	DSC	3	0	0	3	None
Department Specific Elective							
EE212 EE214 EE216 EE218 EE222 EE224	Measurement & Instrumentation Principles of Communication Systems Photonic Integrated Circuits Microcontroller & Embedded Systems Microelectronics Fundamentals of Aerospace Engineering	DSE	3	0	0	3	None
Open Elective							
EE272	Energy Storage Systems	OE	2	0	0	2	None
Skill Enhancement Compulsory Course							
HS232	Life Skills	SECC	2	0	0	2	None
Laboratory							
EE252	Electrical Machines-II Lab	L	0	0	2	1	None
EE254	Power Systems-I Lab	L	0	0	2	1	None
EE256	Signals & Systems Lab	L	0	0	2	1	None
Total Contact Hours – Component wise			19	0	6		-
Total Contact Hours			25			22	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fifth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Department Specific Core							
EE301	Power Systems-II	DSC	3	0	0	3	None
EE303	Power Electronics	DSC	3	0	0	3	None
EE305	Linear Control Systems	DSC	3	0	0	3	None
Department Specific Elective							
EE311 EE313 EE315 EE317 EE319 EE321 EE323	Restructured Power Systems Power System Transients Power Plant Engineering Digital Signal Processing Principles of Digital Communications Sensors & Actuators Aircraft Control Systems	DSE	3	0	0	3	None
Open Elective							
EE371	Fundamentals of Electric Vehicles	OE	2	0	0	2	None
Ability Enhancement Compulsory Course							
EE375	Internship-1	AECC	0	0	0	1	None
Skill Enhancement Compulsory Course							
EE331	Seminar and Technical Report Writing	SECC	0	0	2	1	None
Value Added course/ Dissertation							
EE381	Minor Project-1	VAC	0	0	4	2	None
Laboratory							
EE351	Power Systems-II Lab	L	0	0	2	1	None
EE353	Power Electronics Lab	L	0	0	2	1	None
EE355	Linear Control Systems Lab	L	0	0	2	1	None
Total Contact Hours – Component wise			14	0	12		-
Total Contact Hours			26			21	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Sixth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Department Specific Core							
EE302	Industrial Drives and Control	DSC	3	0	0	3	None
EE304	Switchgear and Protection	DSC	3	0	0	3	None
Department Specific Elective							
EE312 EE314 EE316 EE318 EE322 EE324	FACTS Devices Utilization of Electrical Power Power Electronics for Electric Propulsion Advanced Digital Signal Processing Energy Management and Auditing Robotics and Control: Theory and Practice	DSE	3	0	0	3	None
EE326 EE328 EE332 EE334 EE336 EE338	Operation and Planning of Power Distribution Systems HVAC & HVDC Transmission Systems Modern Radar Systems Renewable Energy Technologies and Assessments Biomedical Instrumentation Unmanned Aerial Vehicles	DSE	3	0	0	3	None
Open Elective							
EE372	Autonomous Drone Technology	OE	2	0	0	2	None
Value Added course/ Dissertation							
VA302	Indian Knowledge System	VAC	2	0	0	2	None
EE382	Minor Project-2	VAC	0	0	4	2	None
Laboratory							
EE352	Industrial Drives and Control Lab	L	0	0	2	1	None
EE354	Switchgear and Protection Lab	L	0	0	2	1	None
EE358	Advanced Signal Processing Lab	L	0	0	2	1	None
Total Contact Hours – Component wise			16	0	10		-
Total Contact Hours			26			21	-

+ DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Seventh Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Department Specific Elective							
EE411 EE413 EE415 EE417 EE419	Wireless Power Transfer Vehicular Technology Electrical Machine Design Industrial Instrumentation Digital Control Systems	DSE	3	0	0	3	None
EE421 EE423 EE425 EE427 EE429	Modeling of Power Converters Adaptive Filtering Principles of Microwave Antennas Wireless and Cellular Communications Advanced Control System Design	DSE	3	0	0	3	None
EE431 EE433 EE435 EE437	Microgrids & Control Systems Advanced Power Electronics Intelligent Systems and Control Optimal Control System	DSE	3	0	0	3	None
EE441 EE443 EE445 EE447 EE449	Smart Grid Technology Renewable and Distributed Generation Special Electrical Machines Substation Engineering Flexible UAV Design	DSE	3	0	0	3	None
Open Elective							
EE471	Energy Internet	OE	2	0	0	2	None
Ability Enhancement Compulsory Course							
EE475	Internship-2	AECC	0	0	0	1	None
Value Added course/ Dissertation							
EE481	Major Project-1	VAC	0	0	8	4	None
Total Contact Hours – Component wise			14	0	8		-
Total Contact Hours			22			19	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Eighth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-Requisite
			L	T	P	C	
Department Specific Elective							
EE412 EE414 EE416 EE418 EE452 EE454	Power System Dynamics Transactive Energy Systems Power Quality Measures and Remedies Modeling and Analysis of Electric Machines Energy Grid Resilience Industrial Automation and Control	DSE	3	0	0	3	None
EE422 EE424 EE426 EE428 EE462 EE464 EE468	Advanced Relaying and Protection Cyber-security of Energy Systems Digital Image Processing Internet of Things Cloud Computing Artificial Intelligence and Machine Learning Advanced Robotics	DSE	3	0	0	3	None
Value Added course/ Dissertation							
EE482	Major Project-2	VAC	0	0	22	11	None
Total Contact Hours – Component wise			6	0	22		-
Total Contact Hours			28			17	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

1st Year: Semester-1

B.Tech - Electrical and Electronics Engineering

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA101	**Engineering Mathematics-I**	**---**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives	To enable the students to have a good understanding of fundamental concepts of single and multivariable calculus.	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To provide the basic and important concepts of linear algebra.		MA101.1	Able to acquire **knowledge** of limit, continuity and differentiation for functions of single and multi-variables and the consequences of different mean value theorems. — **Understand, Analyze**
	To prepare the students to apply the mathematical principles of calculus and linear algebra to solve engineering problems.		MA101.2	Able to **apply** Taylor's series to approximate differentiable functions of single and multi-variables and **estimate** the error. — **Apply, Evaluate**
	To enable the students to have a good understanding of essential methods of statistical inference.		MA101.3	Able to **apply** definite integrals to **evaluate** length of plane curves, volume and surface area of solids of rotation. — **Apply, Evaluate**
			MA101.4	Able to **understand** the basic concepts of vector spaces and to solve systems of linear equations. — **Understand, Evaluate**
			MA101.5	Able to **demonstrate** and **apply** estimation of parameters, confidence interval, and testing hypotheses for normal distribution. — **Understand, Apply**
			MA101.6	Able to **formulate** relationships among random variables using regression and correlation. — **Create**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA101.1	**2**														
MA101.2	**3**														
MA101.3	**3**														
MA101.4	**3**														
MA101.5	**2**														
MA101.6	**3**														
MA101	**2.67**														

SYLLABUS

No.	Content	Hours	COs
I	**Differential Calculus:** Real valued functions of single variable: Limit; continuity; differentiation, Taylor & Maclaurin series, indeterminate forms, L'Hospital's rule. Real valued functions of two/three variables: Limit, continuity, partial differentiation; Taylor and Maclaurin series for function of two variables; Extreme values of functions of two variables.	**14**	**MA101.1 MA101.2**
II	**Integral Calculus:** Definite integral: length of a plane curve, surface area of revolution, volume of solids of revolution; Differentiation under sign of integral: Leibnitz rule; Improper integrals, convergence tests, beta and gamma functions; Multiple Integrals: double and triple integrals, volume and surface integrals.	**16**	**MA101.3**
III	**Linear Algebra:** Vector space over R, subspaces, bases and dimension; Echelon form, rank of a matrix, system of linear equations-direct & iterative methods; eigenvalues and eigenvectors; Symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, and unitary matrices.	**14**	**MA101.4**
IV	**Statistics:** Random variables, Probability distributions, Point estimation of parameters, Confidence Intervals, Testing Hypotheses, goodness of fit: Chi-square test, Regression: fitting straight lines, correlation.	**12**	**MA101.5 MA101.6**
	Total Hours (4 Modules)	**56**	

Essential Readings

1. J. Stewart, D. K. Clegg and S. Watson, "Calculus", Cengage Learning India Pvt. Limited, 9th edition, 2023.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.

Supplementary Readings

1. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.
2. N. Piskunov, "Differential Calculus and Integral Calculus – I", CBS, 1996.
3. N. Piskunov, "Differential Calculus and Integral Calculus – II", CBS, 1996.
4. D. C. Montgomery and G. C. Runger, "Applied Statistics and Probability for Engineers", John Wiley & Sons, 7th edition, 2018.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology (All Branches)**	Year of Regulation	**2024-25**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CB 101	**Engineering Chemistry**	**NIL**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
	To introduce the students to the concept, classifications, and industrial applications of polymers		CB101.1	The students will be apply the knowledge about polymers, polymerization processes, and their industrial applications.	**Apply**
	To gain knowledge of different types of fuels and their analysis		CB101.2	Able to describe different types of fuels and their analysis, petroleum technology	**Understand**
	To learn about metallurgy, metal extraction process, composition, and properties of alloys		CB101.3	Able to explain the process of metal extraction from ores and discuss the properties of alloys and composition	**Analyze**
	To introduce students to different types of materials, properties, and their applications.		CB101.4	Able to analyze the properties of different materials and apply the knowledge of nanotechnology for various practical applications.	**Analyse**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB101.1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.4	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101	2	2	3												

SYLLABUS

No.	Content	Hours	COs
I	**Polymer Chemistry:** Concepts, classification, structures, and molecular weights of polymers, mechanism and kinetics of various polymerization processes, natural rubber and its properties, vulcanization of rubber, synthesis and applications of various industrial polymers, adhesives, paints, conducting polymers and their applications in electronic devices, biodegradable polymers.	**10**	CB101.1
II	**Petroleum Chemistry:** Composition, characteristics of crude oil, cracking. Solid, liquid and gaseous fuels, coal analysis; classification of coal; anti-knocking agents, octane number and cetane number, aviation fuel and biofuels, lubricants.	**08**	CB101.2
III	**Metallurgy:** Minerals, ores, and general methods of extraction and purification of metals (Fe, Al, Cu, Zn). Alloys: Definition of alloy, types of alloys (ferro, non-ferro & amalgam), composition, properties, and uses of brass, bronze, and steel.	**08**	CB101.3
IV	**Material Chemistry:** Introduction and properties of glass, ceramics and their composites, magnetic materials, and smart materials. Piezoceramic materials, electro-active materials, shape-memory materials, energy harvesting materials, self-healing materials, semiconducting materials, and liquid crystals. **Nanomaterials** Introduction, classification, properties of nanomaterials, carbon-based nanomaterials, synthesis of nanomaterials, top-down and bottom-up approaches, characterization of nanomaterials, applications of nanomaterials - materials for light emitting diodes, batteries, and fuel cells, memory devices and sensors, nanotechnology for pharmaceutical applications, nanomaterials for tissue engineering, carbon nanotubes and nanocomposites in textiles.	**16**	CB101.4
	Total Hours	**42**	

Essential Readings

1. P. C. Jain and M. Jain, "Engineering Chemistry", 17th Edition", Dhanpat Rai Publication Co., 2019.
2. S. Chawla, "A Text Book of Engineering Chemistry", 1st Edition, Dhanpat Rai & Co. (P) Limited, 2017

Supplementary Readings

1. M. G. Fontana, "Corrosion Engineering", Third Edition, McGraw-Hill Book Company, 2017
2. R. Gopalan, D. Venkappayya, S. Nagarajan, " A textbook of Engineering Chemistry" 4th Edition, Vikas Publishing House Pvt. Ltd.
3. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications", 2nd edition, Cambridge University Press, 2019

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
PH101	**Engineering Physics**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the concepts of fundamentals of em wave, vectors, vector calculus and its relevance to science and engineering	PH101.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering concepts	Understanding Applying
	To introduce various concepts of special theory of relativity	PH101.2	Able to gain the **knowledge** of special theory of relativity	Understanding
	To introduce various concepts of different optical phenomena observed in nature.	PH101.3	Able to gain the **knowledge** about Geometrical and Physical Optics and its **applications**.	Understanding Applying
	To introduce the developments of Quantum Physics in the beginning of 20th century and the development thereafter.	PH101.4	Able to understand the **concepts** and theories of 20-th century Physics and its **applications**.	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH101.1	**3**	**2**													
PH101.2	**3**	**2**													
PH101.3	**3**	**2**													
PH101.4	**3**	**2**													
PH101	**3**	**2**													

SYLLABUS

No.	Content	Hours	COs
I	**Electromagnetism**: Vector calculus**,** Gauss's law and its applications, divergence and curl of electrostatic fields, electrostatic potential. Lorentz force, Biot-Savart and Ampere's laws and their applications, divergence and curl of magnetostatic fields, force and torque on a magnetic dipole, motional EMF, Faraday's law, Lenz's law, Maxwell's equations, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction.	**14**	**PH101.1, PH101.2**
II	**Optics:** Interference - coherence, principle of superposition, Young's double slit experiment, Newton's rings, diffraction - Fresnel and Fraunhofer diffracting, grating and its usages, polarization, Malus' law, polarization by reflection and Brewster's law.	**14**	**PH101.3**
III	**Modern Physics:** Old quantum theory, black body radiation, Planck's law, photoelectric effect, Compton effect, de-Broglie's hypothesis, Heisenberg uncertainty principle, wave packet, group and phase velocities, postulates of Quantum mechanics. Schrödinger's equation, application in 1-dimension: particle in a box.	**14**	**PH101.4**
	Total Hours	**42**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

Supplementary Readings

1. J. C. Morrison, Modern Physics for Scientists and Engineers, Elsevier; 2nd edition, 2015.
2. M. Mansfield and C. O'Sullivan, "Understanding Physics", Wiley-Blackwell; 3rd Edition, 2020.

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution		
		L	T	P	C	Continuous Evaluation		Total
CB 151	**Chemistry Laboratory**	**0**	**0**	**2**	**1**	**01 Expt.**	**10**	**100**

Course Objectives	To provide the students with knowledge of various titration-based techniques for chemical analysis. To teach the fundamentals of basic chemistry-related aspects for practical applications and sample analysis. To develop the student's ability to use different instrumental methods for chemical analysis and testing of various samples.	Course Outcomes	**COs**	**Statement** / **Bloom's Taxonomy**
			CB151.1	Able to explain the concepts of acid-base, redox, potentiometric and pH metric titration for quantitative analysis — Understand
			CB151.2	Able to prepare standard solutions for various quantitative analysis — Apply
			CB151.3	Able to analyze water sample, alloy samples by complexometric iodometric and spectrophotometric analysis — Analyse
			CB151.4	Able to apply the concepts of partition coefficient, viscosity in analysis — Apply

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB151.1	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
2	CB151.2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
3	CB151.3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
4	CB151.4	**2**	**2**													
	CB151	**2**	**2**													

SYLLABUS

No.	Content	Hours	COs
1	To determine the alkalinity of a given water sample	**2**	CB151.1 CH151.2
2	Estimation of Fe(II) in Mohr's salt solution using standard $KMnO_4$ solution via Redox titration	**2**	CB151.1 CB151.2
3	Conductometric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
4	pH-metric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
5	Complexometric determination of hardness of water	**2**	CB151.3
6	Iodometric determination of copper in brass alloy	**2**	CB151.3
7	Spectrophotometry on copper sulphate solution	**2**	CB151.3
8	Determination of partition coefficient of acetic acid between *n*-butanol and water	**2**	CB151.4
9	Determination of percentage composition of sugar solution from viscosity	**2**	CB151.4
10	Estimation of Fe(II) in a solution using standard $K_2Cr_2O_7$ solution via potentiometric titration	**2**	CB151.1
	Total Hours	**20**	

Essential Readings

1. J. Mendham, R. Denny, J. Barnes, M. Thomas, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson.

Supplementary Readings

1. V. D. Athawale, P. Mathur, "Experimental Physical Chemistry", 1st Edition, New Age International (P) Limited Publishers, 2001.
2. Departmental laboratory manual

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**		Year of Implementation						**2024-2025**
Department	**Physics**		Semester						**I/II**
Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
PH 151	**Engineering Physics Laboratory**	----------	**0**	**0**	**2**	**1**	**01 Experiment**	**10**	**100**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of electromagnetism	Course Outcomes	PH151.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering	Understanding Applying
	To understand various concepts of Optical phenomena in Physics and Engineering		PH151.2	Able to gain the **knowledge** about Geometrical and Physical Optics	Understanding
	To understand the fundamentals of General Physics		PH151.3	Able to **understand** the concepts of General Physics and its **applications**	Understanding Applying
	To understand the fundamentals of Semiconductor Physics		PH 151.4	Able to gain the **knowledge** of Semiconductor Physics and its **applications**	Understanding Applying

COs	Mapping with Program Outcomes (POs)											Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH 151.1	**3**	**2**													
PH 151.2	**3**	**2**													
PH 151.3	**3**	**2**													
PH 151.4	**3**	**2**													
PH 151	**3**	**2**													

SYLLABUS

S. No.	Title of the Experiment	Hours	COs
I	To verify inverse square law (using a point source of light)	**02**	**PH 151.1**
II	To verify Coulomb's Law of force between two electric poles	**02**	
III	To determine the variation of magnetic field along the axis of the current carrying coil	**02**	
IV	To find resonance frequency in series and parallel LCR circuit	**02**	
V	To find the refractive index of prism by measuring angle of prism and angle of minimum deviation	**03**	**PH 151.2**
VI	Determination of wavelength of monochromatic light (LASER) using Fresnel Biprism	**02**	
VII	To determine the wavelength of sodium light by measuring the diameters of Newton's rings	**03**	
VIII	To determine the wavelength of LASER using Diffraction grating	**02**	
IX	To find the refractive index of a glass plate & water by using a travelling microscope	**02**	
X	To determine frequency of A.C. Mains using sonometer	**03**	**PH 151.3**
XI	To determine the Young's modulus of elasticity of the material of a sample beam by bending	**02**	
XII	I-V characteristic curve of a P-N junction in forward bias and reverse bias	**02**	**PH 151.4**
XIII	Half-wave rectifier circuit without and with filter (HWR)	**02**	
XIV	Evaluation and Viva of all experiments	**03**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
XV	Laboratory written test	**01**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
	Total Hours (for any 10 experiments from Sl. No. I to XIII)	**27**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.

2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

2.D. J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India, 5th Edition, 2023

3.A. Ghatak, "Optics", Tata McGraw-Hill, 7th Edition, 2020

Supplementary Readings

1. D. Kleppner, and R. J. Kolenkow, "An Introduction to Mechanics", Cambridge University Press, 2nd Edition, 2021.

2. R. Eisberg, and R. Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley, 2nd Edition, 2006

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 103	**Biology for Engineers**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
	To provide the basic knowledge of various biomolecules, which are essential for life, their structures, and functions.		COs	Statement	**Bloom's Taxonomy**
	To discuss the structure and function of cells, different cellular processes, and biological signal transduction.		CY103.1	Able to understand the significance of biomolecules for sustaining life, including the knowledge of the structure of the cell and the biological signal transduction process.	**Understand**
	To provide the knowledge of heredity, how genes work, the concept of the central dogma of life, genetic engineering, and genomics.		CY103.2	Able to interpret the heredity, variation, and central dogma of life followed by gene expression and their applications.	**Understand**
	To provide basic knowledge on engineering tools in disease biology, stem cell engineering, 3D printing of artificial organs and various biomaterials.		CY103.3	Able to apply the concepts of engineering tools to solve the issues related to disease aspects, diagnosis, etc.	**Apply**
			CY103.4	Able to apply the concepts of biomaterial processing and their applications.	**Apply**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB103.1	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
2	CB103.2	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
3	CB103.3	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
4	CB103.4	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
	CB103	2	3	3												

SYLLABUS

No.	Content	Hours	COs
I	**Molecules of life**: Chemical basis of life, protein structure and function, nucleic acids and the RNA, carbohydrates, lipids, membranes, and cells, cellular interactions, cell cycle, biological signal transduction.	**06**	CB103.1
II	**Gene structure and expression**: Mitosis, meiosis, Mendelian Genetics. DNA and the gene- Synthesis and repair, how genes work, the central dogma of life, transcription, RNA processing, translation, control of gene expression, analyzing and engineering genes, genomics.	**06**	CB103.2
III	**Trends in bioengineering**: Genetic engineering, disease biology and biopharmaceuticals, stem cell engineering, metabolic engineering, biosafety, and bioethics. Bioprinting techniques and materials, 3D printing of ear, bone, and skin. Bioimaging and Artificial Intelligence for disease diagnosis.	**08**	CB103.3
IV	**Biomaterials Processing**: Classification, concept of biocompatibility, quantification of structure-property correlation - bioglass/ glass-ceramics, biodegradable polymers, biocomposites, bioplastics, macroporous scaffolds. Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and bioremediation via microbial surface adsorption (removal of heavy metals like lead, cadmium, mercury, arsenic).	**08**	CB103.4
	Total Hours	**28**	

Essential Readings

1. E. Engner, R. Ross, D. Bailey, "*Concepts in Biology"*, 14th Edition, McGraw Hill Education, New York, 2011.
2. R. Renneberg, V. Berkling and V. Loroch, "Biotechnology for Beginners", 2nd Edition, Academic Press, 2016.

Supplementary Readings

1. G.K. Suraishkumar, "Biology for Engineers", 1st Edition, Oxford University Press, New Delhi, 2019.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", 7th edition, Wiley, New York, 2013.
3. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", 1st Edition, MIT Press, 2008.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
ME101	**Engineering Mechanics**	-----	**3**	1	**0**	**4**	**50**	**50**	**100**	**200**

			COs	Statement	Bloom's Taxonomy
Course Objectives	This course describes the different laws of forces associated with different engineering elements.	Course Outcomes	ME101.1	Able to understand vector mechanics and classify the different laws of forces associated with engineering systems	Knowledge Identification
	This course introduces the use of force, moments and MOIs in various conditions.		ME101.2	Able to i) Illustrate the use of force and moments in various working conditions (Understanding). ii) understand the centre of gravity, centroid, centre of mass and details of MOIs.	Knowledge Identification and Application
	This course illustrates the use of subject knowledge in the fields of engineering.		ME101.3	Able to identify the equilibrium conditions of engineering structures (truss, beams, frames) under various loads.	Knowledge Identification and Analyse
	This course introduces the states of engineering elements and structures under various loading conditions.		ME101.4	Able to solve the basics of friction and its associated laws along with the related problems.	Knowledge Identification and Analyse
	This course explains how to solve the practical problems of mechanics to determine the static forces with their magnitudes and directions.		ME101.5	Able to understand the kinematics of particles and Rigid Bodies and principle of work along with the related problems.	Knowledge Identification and Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ME 101.1	3	2	2	2								2	3	2
ME 101.2	3	2	2	2								2	3	2
ME 101.3	3	2	2	2								2	2	2
ME 101.4	3	2	1	1								2	2	2
ME 101.5	3	2	1	2								2	2	2
ME 101	**3**	**2**	**1.6**	**1.8**								**2**	**2.4**	**2**

SYLLABUS

No.	Content	Hours	COs
I	Vector Mechanics with applications: Definition and representation of vectors, projection and decomposition, force vector and types, dot product, resolving force vector along and perpendicular to a given direction, cross product and scalar triple product	**06**	**ME101.1**
II	Compositions of two force system, Resolution of forces, General method of composition of forces, Equilibrium of bodies, Free body diagram. Lami's theorem, Equilibrium of connected bodies	**06**	**ME101.1**
III	Moment of force, Varignon's theorem, Couple, Resolution of a force into a force and couple, Resultant of non-concurrent force system, Equilibrium of non-concurrent system of forces.	**06**	**ME101.2**
IV	Center of gravity, Centroid, Use of axis of symmetry, Centroid of a composite section, Center of gravity of a flat plate, Difference between center of gravity and centroid, Determination of centroid from first principle.	**06**	**ME101.1 ME101.2 ME101.3**
V	Moment of inertia, Radius of gyration, Polar moment of inertia, Moment of inertia from first principles, Theorems of moment of inertia, Moment of inertia of composite sections, Moment of inertia of standard sections	**06**	**ME101.3**
VI	Frames, Truss, Assumptions in analysis of frame and Truss, Nature of forces, Methods of analysis, Method of joints, Method of sections	**06**	**ME101.3**
VII	Laws of friction, Angle of friction, angle of repose, cone of friction, Wedges, Problems involving non-concurrent force system, Rope/belt friction, pulleys, screw-jack, rolling resistance	**05**	**ME101.1 ME101.2 ME101.4**
VIII	Types of supports, Types of beam, Types of loading, finding reactions at support, shear force and bending moment, axial force and twisting moment, Concept of Stress and Strain – Stress strain, diagram, factor of safety, uniaxial loading, single and double shear, applications. Generalized Hooke's law - Poisson's ratio, Generalized Hooke's law, Relations between E, G and K	**06**	**ME101.2 ME101.4**
IX	Kinematics of Particles and Rigid Bodies: rectilinear motion, curvilinear motion, velocity and acceleration in cylindrical and path coordinate system, relative and constrained motion, rate of change of a vector in a rotating frame, three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics.	**05**	**ME101.1**
X	Work, Work done by varying force, Energy, Power, Work energy equation for translation, Motion of connected bodies, work done by spring	**04**	**ME101.1**
	Total Hours	**56**	

Essential Readings

1. F.P. Bear, E. R. Johnston, Vector Mechanics for Engineers, Tata McGraw Hill, 12th Edition 2019,
2. S. Timoshenko, D.H., Young, JV Rao, S. Pati, Engineering Mechanics, McGraw Hill Education, 5th Edition, 2017

Supplementary Readings

1. H. J. Shah, S. B. Junarkar, Applied Mechanics, Charotar Publication, 19th Edition 2015
2. S. S. Bhavikatti, K. G. Rajashekarappa, Engineering Mechanics, Wiley Eastern Ltd., 2018
3. R. C. Hibbeler, Engineering Mechanics –Statics & Dynamics, Macmillan Publication Co., 11th Edition, 2006

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS101	**Computer and Coding**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the basic architecture of a computer, the concept of algorithm, the basic concepts and terminology of programming in general and concept of functional hierarchical code organization.**	Course Outcomes	CS101.1	**Able to explain the basic architecture of a computer, the concept of algorithm, and the basic concepts and terminology of programming in general.**	Understand
	To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.		CS101.2	**Able to develop the ability to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
	To introduce programming using C language and writing programs in C on a computer, and edit, compile, debug, correct, recompile and run those.		CS101.3	**Able to apply the C programming language to implement various algorithms.**	Apply
	To train the students in choosing right data representation formats based on a problem specification.		CS101.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
			CS101.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
			CS101.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS101.1	3		1		1					1	1	1			
CS101.2	2	3	3	2	1	1			1				1	1	1
CS101.3	3	3	3	2	1				1					1	1
CS101.4	3	1	1	2										2	3
CS101.5	3		3	1	3				1					1	1
CS101.6	3	2	2	2					2						1
CS101	2.83	2.25	2.17	1.80	1.50	1.00			1.25	1.00	1.00	1.00	1.00	1.25	1.40

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Organization of a Computer: Von Neumann architecture; CPU; Memory; RAM; ROM; Hardware; Software; Application Programs; System Programs; Operating Systems; Number Systems.** **Concept of Programming and Programming Languages: Machine Language; Assembly Language; High-Level Programming language; Compiler; Assembler; Interpreter; Linker; Loader; Compiling a C program in command line and in an IDE** **Concept of Algorithm, Flowchart, Pseudo code, Illustrative Problem Solving Examples.**	**5**	**CS101.1** **CS101.2**
II	**Introduction to C programming language** **Features of a Programming Language: Character Set; Constants; Escape Sequences; Identifiers; Keywords; Data Types; Data Type Qualifiers; Variables; Declarations; enum; typedef; Operators & Expressions - Binary operators :- Arithmetic Operators, Logical Operators, Relational Operators, Bitwise Operators; Assignment Operator; Shorthand Assignment Operators; Unary Operators; Ternary Operators; Special Operators; sizeof(); Operator Precedence and Associativity in expressions; Data type conversion: coercion (implicit type conversion), type casting (explicit type conversion); Statements: Assignment statements, Input/ Output statements for standard input/ output devices.** **Flow Control - Conditionals and Branching:- Simple if Statement, if-else Statement, Nested if-else Statement, Ladder structure of if-else, switch-case statement, goto statement;** **Iteration - while Statement, do-while Statement, for Statement, break and continue.** **Functions; Function Types - standard library functions, user defined functions; syntax of functions; Arguments and Parameters; Call by Value; Call by Reference; parameterized main function; Storage Classes - auto, register, static, extern; Scope Rule: Variable scope - local, global; Recursion.** **Arrays - Single Dimensional Arrays, Multi-Dimensional Arrays, Introduction to strings :- Definition of a string, character arrays and strings, pointers and strings, standard library string functions, arrays of strings; Pointers - different types of pointers, pointer arithmetic, pointers and arrays.** **Structures - creating structures using struct, Arrays in Structures, Array of Structures, Difference between arrays and structures; Unions - creating structures using union, difference between structures and unions.** **Preprocessor directives and Files - Preprocessor directives :- File inclusion by macro, macros, macros and functions; Basic Input/ Output operations on Files :- Text files and binary files, file opening modes, opening, closing, reading, writing and appending to a file.** **(A programming language like C/ C++ shall be used as a basis language. The same language is to be used for the laboratory).**	**23**	**CS101.3** **CS101.4** **CS101.5** **CS101.6**
Total Hours		**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.
2. V. Rajaraman, "Fundamentals of Computers", PHI Learning, 6th revised edition, 2014.

3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.

2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.

3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS151	**Computer & Coding Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce programming using C language and to write programs in C on a computer, and to edit, compile, debug, correct, recompile and run those.**	Course Outcomes	CS151.1	**Able to explain the basic concepts and terminology of programming in general.**	Understand)
	To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.		CS151.2	**Able to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
	To train the students in choosing right data representation formats based on a problem specification.		CS151.3	**Able to use the C programming language to implement various algorithms.**	Apply
			CS151.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
			CS151.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
			CS151.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS151.1	3		1		1					1	1	1			
CS151.2	2	3	3	2	1	1			1					1	
CS151.3	3	3	3	2	1				1					3	
CS151.4	3	2	1	2										1	
CS151.5	3		3	2	3	1			1					2	
CS151.6	3	2	2	2					2					1	
CS151	**2.83**	**2.50**	**2.17**	**2.00**	**1.50**	**1.00**			**1.25**	**1**	**1**	**1**		**1.60**	

SYLLABUS

No.	Content	Hours	COs
I	1. C program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. C program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a + ab^2}{\sqrt{a^2+9}}$	**02**	**CS101.1** **CS101.2** **CS101.3** **CS101.4** **CS101.5** **CS101.6**
II	3. C program to check a given number is odd or even and positive or negative. 4. C program to read three numbers and find the greatest one.	**02**	
III	5. C program to read five numbers and find the second smallest number. 6. C program to find GCD and LCM of two numbers.	**02**	
IV	7. C program to store ten numbers in an array and find the largest and smallest. 8. C program to store N numbers in an array and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. C program to check whether a given number is prime or not. 10. C program to print first N numbers of Fibonacci series.	**02**	
VI	11. C program to find a key from n numbers using sequential search (Linear search), and if found, show the position. 12. Implementation of an algorithm to insert an element at any arbitrary position in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after insertion.	**04**	
VII	13. Implementation of an algorithm to delete an element in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after deletion. 14. Implementation of an algorithm to reverse the elements of an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after reversal.	**04**	
VIII	15. C program to solve Tower of Hanoi problem for n disks. 16. C program to generate n Fibonacci numbers using both recursive and non-recursive methods.	**04**	
IX	17. C program to implement a swap function to swap the values of two variables. 18. C program to store the name, roll number, marks and grades of 5 students using array of structure.	**04**	
X	19. C program to create a file named "StudentDatabase" and storing the name, roll number, phone number and average marks of N students, where N is a natural number between 2 to 10.	**02**	
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.

2. V. Rajaraman, “Fundamentals of Computers”, PHI Learning, 6th revised edition, 2014.
3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.
Supplementary Readings
1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.
2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.
3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE 101	**Engineering Graphics**	**-----**	**0**	**1**	**3**	**2**	**50**	**50**	**100**	**200**

Course Objectives

- To develop the student's ability to understand the role and importance of technical drawings in engineering drawing process, and application of BIS and ISO conventions.
- To develop the student's ability to understand the proper representation and practice of Lines, Lettering, and dimensioning.
- To develop student's ability to understand the importance of types of scales.
- To develop the student's ability to construct plane geometry.
- To develop the student's ability to understand the concepts of projection and their application in technical drawing.
- To develop the student's ability to apply projection technique to draw Multi-view, pictorial view (Isometric View) drawings.
- To develop the student's ability to understand development process of surfaces of various objects.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE101.1	Able to acquire knowledge about BIS conventions and it's application to draw letters, lines and dimensions.	Knowledge Application
CE101.2	Able to acquire knowledge about developing various types of scales associated with engineering drawing and it's application.	Knowledge Application
CE101.3	Able to acquire knowledge about constructing points, lines, curves, polygons, planes, solids etc. and it's application.	Knowledge Application
CE101.4	Able to acquire knowledge about the system of projection with respect to the observer, object, the reference planes and it's application.	Knowledge Application
CE101.5	Able to acquire knowledge about creating orthographic, isometric, multi-view drawing, and sectional views of objects and it's application.	Knowledge Application
CE101.6	Able to acquire knowledge about the development process of surfaces of various objects and it's application.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE101.1	2	2	2		2				1	3		1	3		
CE101.2	2	2	2		2				1	3		1	3		
CE101.3	2	2	2		2				1	3		1	3		
CE101.4	2	2	2		2				1	3		1	3		
CE101.5	2	2	2		2				1	3		1	3		
CE101.6	2	2	2		2				1	3		1	3		
CE101	**2**	**2**	**2**		**2**				**1**	**3**		**1**	**3**		

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Importance of Engineering Drawing, drawing Instruments and materials, B.I.S. and ISO conventions, Lines, Lettering, and Dimensioning	**02**	**CE101.1**
II	**Scales:** Construction of scales – plane scale, diagonal scale, Vernier scale, functional scale; concept of conversion scale and nomogram	**02**	**CE101.2**
III	**Plane Geometry:** Geometrical Construction: line, arc, and angle, divisions of straight line and circumference, construction of polygon	**02**	**CE101.3**
IV	**Conic Sections and other Curves:** Construction of Ellipse, Parabola, Hyperbola, Rectangular Hyperbola, Cycloidal Curves: Cycloid, Involute	**02**	**CE101.3**
V	**Projection:** Principle of Projection and Orthographic Projection, Projection of points and lines, Projection of Planes.	**03**	**CE101.4**
VI	**Solid Geometry:** Types of Solids: polyhedral, prisms, pyramids, cylinder, cone, sphere, auxiliary projection method, Orthographic projection of solids: one view, two view and three view drawings, Missing view, rules for selection of views.	**03**	**CE101.4**
VII	Sectional view, section plane perpendicular to the HP & VP and other Various positions, true shape of sections.	**03**	**CE101.4**

VIII	Classification, line of intersection, line/generator method and section plane method: intersection of two prisms, two cylinders, intersection of cone and cylinder	**03**	**CE101.4**
IX	Terminology, isometric scale, isometric view and isometric projection, isometric axes, and lines, missing view	**02**	**CE101.5**
X	Method of development, parallel line development, radial line development, developments of cylinder, cone, prism, pyramid, true length of edges – oblique surface.	**02**	**CE101.6**
XI	Introduction to CAD software	**04**	**All COs**
Total Hours		**28**	

Essential Readings

1. N.D. Bhatt, Engineering Drawing, Chrotar Publishing House, 2011.
2. Dhananjay A Jolhe, Engineering drawing, TMH, 2008
3. M.B. Shah and B.C. Rana, Engineering Drawing, Pearson, 2009.

Supplementary Readings

1. T E French, C J Vierck and R J Foster, Graphic Science and Design, 4th edition, McGraw Hill, 1984
2. W J Luzadder and J M Duff, Fundamentals of Engineering Drawing, 11th edition, Prentice-Hall of India, 1995.
3. K Venugpoal, Engineering Drawing and Graphics, 3nd edition, New Age International, 1998.
4. Gary R. Bertoline, Eric N. Wiebe, Nathan W. Hartman, William A. Ross, Technical graphics Communication, 4th Edition, McGraw Hill Higher Education, 2009
5. Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, Cindy M. Johnson Technical Drawing With Engineering Graphics, 15th Edition, Prentice Hall, 2016
6. SP 46: 2003, Engineering Drawing Practice for schools and colleges.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
HS151	**Communication Skills**	**Nil**	**0**	**1**	**2**	**2**	**01 Experiment X 10**	**100**

Course Objectives

- To introduce the basic concepts of communication
- To improve English communication skills of students which are essential to succeed in today's business environment.
- To improve oratory skills and body language
- To develop the ability to critically analyze topics and contexts independently or in groups

Course Outcomes

	Statement	Bloom's Taxonomy
HS151.1	Describe and apply the skill of listening in Communicative English	Apply
HS151.2	Demonstrate good reading skills in English	Apply
HS151.3	Demonstrate good writing skills in English	Apply
HS151.4	Demonstrate good oratory skills in English	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS151.1	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.2	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.3	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.4	-	-	-	-	-	-	-	-	1	3	-	3			
HS151	-	-	-	-	-	-	-	-	1.0	3.0	-	3.0			

SYLLABUS

No.	Activities/Experiments	Hours	COs
I	Short speeches or other audio files: Listening; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
II	Short movies or other video files: Watching; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
III	Unseen comprehension: Reading passages or essays; Conversing with the teacher or other students; Writing a summary or answering questions	6	HS151.2
IV	Written composition: Writing paragraphs and argumentative and narrative essays; Letter writing–official, personal, job application; Notice writing; Reports	12	HS151.3
V	Oratory: Greetings & introductions; Extempore; Debate; Group discussion; Individual/group seminar presentations; Vocabulary building; Taking and giving interviews; pronunciation skills exercises	12	HS151.4
	Total Hours	**42**	

Essential Readings

1. C. Muralikrishna and Sunita Mishra, *Communication Skills for Engineers*, Pearson, 2nd Edition, 2011.
2. Nitin Bhatnagar and Mamta Bhatnagar, *Communicative English for Engineers and Professionals*, Pearson, 2010.

Supplementary Readings

1. J. K. Gangal, *A Practical Course for Developing Writing Skills in English*, PHI, 2011.
2. John Seely, *Oxford Guide to Effective Writing and Speaking*, Oxford University Press, 3rd Edition, 2013.
3. Sanjay Kumar and Pushp Lata, *Communication Skills*, Oxford University Press, 2nd Edition, 2015.

1st Year: Semester-2

B.Tech - Electrical and Electronics Engineering

	National Institute of Technology Meghalaya An Institute of National Importance								CURRICULUM
Programme	**Bachelor of Technology**						Year of Regulation		**2024-25**
Department	**Mathematics**						Semester		**II**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA 102	**Engineering Mathematics-II**	**NIL**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	1. To introduce the fundamental concepts of various engineering mathematics tools involving integral transforms, differential equations and complex variables. 2. To develop problem-solving and critical thinking skills in engineering mathematics.	Course Outcomes	MA102.1	Able to **describe** the basic concepts of Fourier series, Fourier transform, Laplace transform and their applications.	**Understand**
			MA102.2	Able to s**olve** ordinary differential equations analytically and **implement** the ODEs to model real world problems.	**Apply**
			MA102.3	Able to **compare** second order PDEs and **solve** Laplace, heat and wave equations using Fourier series.	**Analyze Apply**
			MA102.4	Able to **recognize** analytic functions, **solve** contour integrals and **determine** the Taylor and Laurent series expansions.	**Understand Apply**
			MA102.5	Able to **use** the basic knowledge of engineering Mathematics in solving real-world problems .	**Apply**
			MA102.6	Able to **apply** Gauss' divergence theorem, Stokes' theorem and Green's theorem to evaluate double and triple integrals	**Apply**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA102.1	**3**														
MA102.2	**3**														
MA102.3	**3**														
MA102.4	**3**														
MA102.5	**3**														
MA102.6	**3**														
MA102	**3**														

SYLLABUS

No.	Content	Hours	COs
I	**Integral Transforms:** Fourier series of a function with arbitrary period, Fourier series of even and odd functions, half-range Fourier series, Fourier Transform: Fourier integral theorem, Fourier sine and cosine integrals, complex form of Fourier integral, Fourier transform of derivative of a function, applications of Fourier transform in boundary value problems; Laplace Transform: Laplace transform of a function, existence theorem, Laplace transform of derivatives and integrals, inverse Laplace transform, convolution theorem.	**13**	**MA102.1 MA102.5**
II	**Ordinary Differential Equations:** First order ordinary differential equations: exact, integrating factors, linear and Bernoulli's equations, Higher order differential equations with constant coefficients, Cauchy-Euler equations, method of variation of parameters, system of differential equations. Use of Laplace and Fourier transform in solving ordinary differential equations**.**	**12**	**MA102.2 MA102.5**
III	**Partial Differential Equations:** First order partial differential equation: linear, semi-linear, quasi-linear, and non-linear types. Classification of integrals. Lagrange's method of solution and its geometrical interpretation, compatibility condition, Charpit's method, special types of first order equations. Method of separation of variables to solve Wave equation, Laplace equation, Heat equation. Use of Laplace and Fourier transform in solving partial differential equations**.**	**13**	**MA102.2 MA102.5**
IV	**Complex Analysis:** Basic concept of complex numbers, limits, continuity and differentiability of a complex valued function of a complex variable, analytic functions, Cauchy-Riemann Equations, harmonic functions, complex exponential, trigonometric, hyperbolic and logarithmic functions, line integral in complex plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor and Laurent series, singularities.	**12**	**MA102.4 MA102.5**
V	**Vector Calculus:** Gradient, divergence, curl; Green's theorem; Gauss' divergence theorem; Stokes' theorem.	**06**	**MA102.6**
	Total Hours (5 Modules)	**56**	

Essential Readings

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.
2. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.

Supplementary Readings
1. P. Dyke, “An Introduction to Laplace Transforms and Fourier Series”, Springer Nature; 2nd edition, 2014.
2. Shepley L. Ross, “Differential Equations”, John Wiley & Sons, Inc, 3rd edition 2007.
3. S. J. Farlow, “Partial Differential Equations for Scientist and Engineers”, Dover Publications, 2003.
4. J. W. Brown and R. V. Churchill, “Complex Variables and Applications”, McGraw Hill; 9th edition, 2021.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
PH101	**Engineering Physics**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the concepts of fundamentals of em wave, vectors, vector calculus and its relevance to science and engineering	PH101.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering concepts	Understanding Applying
	To introduce various concepts of special theory of relativity	PH101.2	Able to gain the **knowledge** of special theory of relativity	Understanding
	To introduce various concepts of different optical phenomena observed in nature.	PH101.3	Able to gain the **knowledge** about Geometrical and Physical Optics and its **applications**.	Understanding Applying
	To introduce the developments of Quantum Physics in the beginning of 20th century and the development thereafter.	PH101.4	Able to understand the **concepts** and theories of 20-th century Physics and its **applications**.	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH101.1	**3**	**2**													
PH101.2	**3**	**2**													
PH101.3	**3**	**2**													
PH101.4	**3**	**2**													
PH101	**3**	**2**													

SYLLABUS

No.	Content	Hours	COs
I	**Electromagnetism**: Vector calculus**,** Gauss's law and its applications, divergence and curl of electrostatic fields, electrostatic potential. Lorentz force, Biot-Savart and Ampere's laws and their applications, divergence and curl of magnetostatic fields, force and torque on a magnetic dipole, motional EMF, Faraday's law, Lenz's law, Maxwell's equations, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction.	**14**	**PH101.1, PH101.2**
II	**Optics:** Interference - coherence, principle of superposition, Young's double slit experiment, Newton's rings, diffraction - Fresnel and Fraunhofer diffracting, grating and its usages, polarization, Malus' law, polarization by reflection and Brewster's law.	**14**	**PH101.3**
III	**Modern Physics:** Old quantum theory, black body radiation, Planck's law, photoelectric effect, Compton effect, de-Broglie's hypothesis, Heisenberg uncertainty principle, wave packet, group and phase velocities, postulates of Quantum mechanics. Schrödinger's equation, application in 1-dimension: particle in a box.	**14**	**PH101.4**
	Total Hours	**42**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

Supplementary Readings

1. J. C. Morrison, Modern Physics for Scientists and Engineers, Elsevier; 2nd edition, 2015.
2. M. Mansfield and C. O'Sullivan, "Understanding Physics", Wiley-Blackwell; 3rd Edition, 2020.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology (All Branches)**	Year of Regulation	**2024-25**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CB 101	**Engineering Chemistry**	**NIL**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
	To introduce the students to the concept, classifications, and industrial applications of polymers		CB101.1	The students will be apply the knowledge about polymers, polymerization processes, and their industrial applications.	**Apply**
	To gain knowledge of different types of fuels and their analysis		CB101.2	Able to describe different types of fuels and their analysis, petroleum technology	**Understand**
	To learn about metallurgy, metal extraction process, composition, and properties of alloys		CB101.3	Able to explain the process of metal extraction from ores and discuss the properties of alloys and composition	**Analyze**
	To introduce students to different types of materials, properties, and their applications.		CB101.4	Able to analyze the properties of different materials and apply the knowledge of nanotechnology for various practical applications.	**Analyse**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB101.1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.4	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101	2	2	3												

SYLLABUS

No.	Content	Hours	COs
I	**Polymer Chemistry:** Concepts, classification, structures, and molecular weights of polymers, mechanism and kinetics of various polymerization processes, natural rubber and its properties, vulcanization of rubber, synthesis and applications of various industrial polymers, adhesives, paints, conducting polymers and their applications in electronic devices, biodegradable polymers.	**10**	CB101.1
II	**Petroleum Chemistry:** Composition, characteristics of crude oil, cracking. Solid, liquid and gaseous fuels, coal analysis; classification of coal; anti-knocking agents, octane number and cetane number, aviation fuel and biofuels, lubricants.	**08**	CB101.2
III	**Metallurgy:** Minerals, ores, and general methods of extraction and purification of metals (Fe, Al, Cu, Zn). Alloys: Definition of alloy, types of alloys (ferro, non-ferro & amalgam), composition, properties, and uses of brass, bronze, and steel.	**08**	CB101.3
IV	**Material Chemistry:** Introduction and properties of glass, ceramics and their composites, magnetic materials, and smart materials. Piezoceramic materials, electro-active materials, shape-memory materials, energy harvesting materials, self-healing materials, semiconducting materials, and liquid crystals. **Nanomaterials** Introduction, classification, properties of nanomaterials, carbon-based nanomaterials, synthesis of nanomaterials, top-down and bottom-up approaches, characterization of nanomaterials, applications of nanomaterials - materials for light emitting diodes, batteries, and fuel cells, memory devices and sensors, nanotechnology for pharmaceutical applications, nanomaterials for tissue engineering, carbon nanotubes and nanocomposites in textiles.	**16**	CB101.4
	Total Hours	**42**	

Essential Readings

1. P. C. Jain and M. Jain, "Engineering Chemistry", 17th Edition", Dhanpat Rai Publication Co., 2019.
2. S. Chawla, "A Text Book of Engineering Chemistry", 1st Edition, Dhanpat Rai & Co. (P) Limited, 2017

Supplementary Readings

1. M. G. Fontana, "Corrosion Engineering", Third Edition, McGraw-Hill Book Company, 2017
2. R. Gopalan, D. Venkappayya, S. Nagarajan, " A textbook of Engineering Chemistry" 4th Edition, Vikas Publishing House Pvt. Ltd.
3. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications", 2nd edition, Cambridge University Press, 2019

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**		Year of Implementation						**2024-2025**
Department	**Physics**		Semester						**I/II**
Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
PH 151	**Engineering Physics Laboratory**	----------	**0**	**0**	**2**	**1**	**01 Experiment**	**10**	**100**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of electromagnetism	Course Outcomes	PH151.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering	Understanding Applying
	To understand various concepts of Optical phenomena in Physics and Engineering		PH151.2	Able to gain the **knowledge** about Geometrical and Physical Optics	Understanding
	To understand the fundamentals of General Physics		PH151.3	Able to **understand** the concepts of General Physics and its **applications**	Understanding Applying
	To understand the fundamentals of Semiconductor Physics		PH 151.4	Able to gain the **knowledge** of Semiconductor Physics and its **applications**	Understanding Applying

COs	Mapping with Program Outcomes (POs)											Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH 151.1	**3**	**2**													
PH 151.2	**3**	**2**													
PH 151.3	**3**	**2**													
PH 151.4	**3**	**2**													
PH 151	**3**	**2**													

SYLLABUS

S. No.	Title of the Experiment	Hours	COs
I	To verify inverse square law (using a point source of light)	**02**	**PH 151.1**
II	To verify Coulomb's Law of force between two electric poles	**02**	
III	To determine the variation of magnetic field along the axis of the current carrying coil	**02**	
IV	To find resonance frequency in series and parallel LCR circuit	**02**	
V	To find the refractive index of prism by measuring angle of prism and angle of minimum deviation	**03**	**PH 151.2**
VI	Determination of wavelength of monochromatic light (LASER) using Fresnel Biprism	**02**	
VII	To determine the wavelength of sodium light by measuring the diameters of Newton's rings	**03**	
VIII	To determine the wavelength of LASER using Diffraction grating	**02**	
IX	To find the refractive index of a glass plate & water by using a travelling microscope	**02**	
X	To determine frequency of A.C. Mains using sonometer	**03**	**PH 151.3**
XI	To determine the Young's modulus of elasticity of the material of a sample beam by bending	**02**	
XII	I-V characteristic curve of a P-N junction in forward bias and reverse bias	**02**	**PH 151.4**
XIII	Half-wave rectifier circuit without and with filter (HWR)	**02**	
XIV	Evaluation and Viva of all experiments	**03**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
XV	Laboratory written test	**01**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
	Total Hours (for any 10 experiments from Sl. No. I to XIII)	**27**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.

2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

2.D. J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India, 5th Edition, 2023

3.A. Ghatak, "Optics", Tata McGraw-Hill, 7th Edition, 2020

Supplementary Readings

1. D. Kleppner, and R. J. Kolenkow, "An Introduction to Mechanics", Cambridge University Press, 2nd Edition, 2021.

2. R. Eisberg, and R. Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley, 2nd Edition, 2006

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution		
		L	T	P	C	Continuous Evaluation		Total
CB 151	**Chemistry Laboratory**	**0**	**0**	**2**	**1**	**01 Expt.**	**10**	**100**

Course Objectives	To provide the students with knowledge of various titration-based techniques for chemical analysis. To teach the fundamentals of basic chemistry-related aspects for practical applications and sample analysis. To develop the student's ability to use different instrumental methods for chemical analysis and testing of various samples.	Course Outcomes	**COs**	**Statement** / **Bloom's Taxonomy**
			CB151.1	Able to explain the concepts of acid-base, redox, potentiometric and pH metric titration for quantitative analysis — Understand
			CB151.2	Able to prepare standard solutions for various quantitative analysis — Apply
			CB151.3	Able to analyze water sample, alloy samples by complexometric iodometric and spectrophotometric analysis — Analyse
			CB151.4	Able to apply the concepts of partition coefficient, viscosity in analysis — Apply

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB151.1	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
2	CB151.2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
3	CB151.3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
4	CB151.4	**2**	**2**													
	CB151	**2**	**2**													

SYLLABUS

No.	Content	Hours	COs
1	To determine the alkalinity of a given water sample	**2**	CB151.1 CH151.2
2	Estimation of Fe(II) in Mohr's salt solution using standard $KMnO_4$ solution via Redox titration	**2**	CB151.1 CB151.2
3	Conductometric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
4	pH-metric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
5	Complexometric determination of hardness of water	**2**	CB151.3
6	Iodometric determination of copper in brass alloy	**2**	CB151.3
7	Spectrophotometry on copper sulphate solution	**2**	CB151.3
8	Determination of partition coefficient of acetic acid between *n*-butanol and water	**2**	CB151.4
9	Determination of percentage composition of sugar solution from viscosity	**2**	CB151.4
10	Estimation of Fe(II) in a solution using standard $K_2Cr_2O_7$ solution via potentiometric titration	**2**	CB151.1
	Total Hours	**20**	

Essential Readings

1. J. Mendham, R. Denny, J. Barnes, M. Thomas, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson.

Supplementary Readings

1. V. D. Athawale, P. Mathur, "Experimental Physical Chemistry", 1st Edition, New Age International (P) Limited Publishers, 2001.
2. Departmental laboratory manual

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 102	**Environmental Science**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			COs		**Bloom's taxonomy**
Course Objectives	To introduce students to natural resources and the impact of various human activities on natural resources and the environment.	Course Outcomes	CB102.1	The students will be able to discuss various types of natural resources, their proper utilization, and conservation for maintaining ecological balance.	**Understand**
	To provide basic knowledge about the environment and its related socio-economic problems, environment protection, and environment improvement programs.		CB102.2	Able to analyze the impacts of various types of pollutants on the environment and provide a proper scientific and technical solutions to control them.	**Analyze**
	To study the causes and effects of air, and water pollution and the techniques for monitoring air and water quality in the environment.		CB102.3	Able to apply different techniques to manage solid wastes and recovery of useful materials from wastes.	**Apply**
	To provide basic knowledge and overview of solid waste management and its impact on human health and surrounding environments.		CB102.4	Able to understand the features of renewable energy resources and their importance for sustainable development.	**Understand**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB102.1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
2	CB102.2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
3	CB102.3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
4	CB102.4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	CB102							2								

SYLLABUS

No.	Content	Hours	COs
I	**Natural resources:** Scope and importance, concept of sustainability and sustainable development. Land resources- Land degradation, soil erosion and desertification. Deforestation; impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water- Surface and ground water, floods, droughts, population growth, and associated problems.	**05**	CB102.1 CB102.2
II	**Human communities and the Environment:** Demography, population, population explosion and population control, family welfare programs, resettlement and rehabilitation of affected persons, case studies. Disaster management- flood, earthquake, cyclones and landslides. Environmental movements – Chipko, Silent valley and Bishnois of Rajasthan. Environmental ethics, environmental conservations, public awareness. Environmental Protection Acts.	**04**	CB102.1
III	**Air pollution:** Source and effect of pollutants, primary and secondary pollutants, control measures. Acid rain and its impacts. Green-house effects and their impact on global climate change. Depletion of the ozone layer and its effects. Air pollution monitoring techniques. **Water pollution:** Natural water, pollutants- their origin and effects, oxygen demanding wastes, pathogens, nutrients, salts, heavy metals, pesticides, volatile organic compounds. River/ lake/ ground water pollution. Water pollution monitoring techniques	**08**	CB102.2
IV	**Solid Waste Management:** Municipal, industrial, commercial, agricultural, hazardous solid wastes, recovery and conversion method of waste and waste management, land filling/disposal, incineration, composting. Environment management and sustainability tools (material management and recovery planning) for sustainable management including ISO, RIOS & R2 certifications, environment audit. E-waste- composition and generation, global context in e- waste, effects of pollutant (E- waste) on human health and surrounding environment, e-waste control measures, steps in recycling and recovery of materials from e-waste.	**07**	CB102.3
V	**Energy Resources:** Renewable and non-renewable energy sources, use of alternate energy sources [solar energy, hydro (tidal) energy, wind energy, geothermal, biomass, nuclear energy).	**04**	CB102.4
	Total Hours	**28**	

Essential Readings

1. A. Basak, "Environmental Studies", 2nd Edition, Pearson, 2015.
2. D. Dave and S.S. Katewa, "Text Book of Environmental Studies", Cenage Learning, 2nd Edition, 2012.

Supplementary Readings

1. R. Daniels and J. Khrishnaswamy, "Environmental Studies", 1st Edition, Wiley, 2009.
2. A. Khan, Inamuddin, A. M. Asiri "E-waste Recycling and Management", Springer Nature Switzerland AG, 2020

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology in Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE102	**Basic Electrical & Electronics Engineering**	**No**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To understand basic circuit theorems and laws	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To develop the skills to analyze the basic DC/AC system		EE102.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits — Knowledge Application
	To introduce the principle of semiconductor physics		EE102.2	Understand the laws of electricity and magnetism and apply them in simple circuits — Knowledge Synthesis
	To understand the concept of diode and its applications		EE102.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power — Comprehension Application
	To understand the fundamentals of Bipolar Junction Transistors		EE102.4	Able to acquire knowledge about the fundamentals of semiconductor physics. — Knowledge Synthesis
			EE102.5	Able to gather knowledge about diode and its applications. — Knowledge Application
			EE102.6	Able to understand the Bipolar Junction Transistors — Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**					**2**		**2**	**3**
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**					**2**		**2**	**3**
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**					**2**		**2**	**3**
EE102.4	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102.5	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102.6	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102	**3.00**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**					**2.00**	**2.00**	**2.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Analysis of DC circuits** Mesh, node, branch, Ohm's law, series and parallel circuit, basic devices: resistors, capacitors, inductors, dependent and independent sources, Kirchhoff's Laws, Mesh and Node Analysis, Star-Delta conversion, Superposition theorem, Source conversion, Thevenin theorem, Norton theorem, Maximum power transfer theorem.	**07**	**CO1**
II	**Electromagnetic Induction & Magnetic Circuit** Magnetic field, Right hand rule, Left hand rule, Electromechanical laws, relation between electricity and magnetism, production of emfs (ac & dc), Faraday's law of electromagnetic induction, direction of induced emf, Lenz law, dynamically and statically induced emfs, self-inductances, and mutual inductances, coefficient of coupling, Inductance in series and parallel, energy stored in a magnetic field.	**07**	**CO2**
III	**A.C Fundamentals and R.L.C circuits** Phasors, Complex quantities, Application of complex algebra to A.C circuit, series and parallel RL, RC, RLC circuit, concept of impedance triangle, complex power: active, reactive and apparent power, power triangle, admittance triangle, series parallel circuit. Balanced two phase and three phase systems, Balanced Star-Delta connections, phase and line currents and voltages and their relations, Measurement of three phase power.	**07**	**CO3**
IV	**Introduction to Semiconductors:** Fundamentals of semiconductor, Energy Bandgap, intrinsic and extrinsic semiconductors, Mobility, Conductivity & Resistivity.	**05**	**CO4**
V	**Diodes & applications**: Physical structure and working mechanism of the p-n junction, p-n junction under forward & reverse bias, I/V characteristics, Half wave & full-wave, bridge rectifiers.	**08**	**CO5**
VI	**Bipolar Junction Transistors:** Physical structure and working mechanism of BJT transistors, Input Output characteristics, Regions of operation, Transistor configurations: CB, CE, CC.	**08**	**CO6**
	Total Hours	**42**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.
2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013

3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2006

Supplementary Readings

1. A. Chakroborty, S. Nath and C.K. Chanda, “Basic Electrical Engineering”, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
2. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
3. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
4. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2017.
5. https://onlinecourses.nptel.ac.in/noc21_ee55/preview

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE152	**Basic Electrical and Electronics Engineering Lab**	**EE**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand basic circuit theorems and laws	Course Outcomes	EE152.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits	Knowledge Application
	To develop the skills to analyze the basic DC/AC system		EE152.2	Understand the laws of electricity and magnetism and apply them in simple circuits	Knowledge Synthesis
	To develop the student's ability to apply the basic principles of electronics in circuit designing		EE152.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power	Comprehension Application
	To develop the student's ability to design circuits based on diode		EE152.4	Verify the V-I characteristics of the basic diodes	Knowledge Application
	To develop the student's ability to study characteristics of BJT		EE152.5	Study the operational mechanism of diode circuits as a rectifier	Knowledge Application
			EE152.6	Study the characterises of BJT	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.4	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102.5	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102.6	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102	**3.00**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**					**2.00**	**1.00**	**2.00**	**2.40**	

SYLLABUS

No.	Content	Hours	COs
1	Study and verification of Kirchhoff's Current Law & Kirchhoff's voltage law applied to D.C. circuit.	**02**	**CO1**
2	To Study & Verify the Maximum Power Transfer theorem.	**02**	**CO1**
3	To find the inductance of the choke coil.	**02**	**CO2**
4	To study the R-L-C series circuit.	**02**	**CO3**
5	To study three-phase power measurement using The two-wattmeter method.	**02**	**CO3**
6	I-V characteristics of forward biased P-N junction Diode.	**02**	**CO4**
7	Reverse characteristics of Zener Diode.	**02**	**CO4**
8	Half-wave rectifier using diode.	**02**	**CO5**
9	Full-wave rectifier using diode.	**02**	**CO5**
10	Input & output characteristics of BJT in CE mode.	**02**	**CO6**
	Total Hours	**20**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.
2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013
3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2006

Supplementary Readings

4. A. Chakroborty, S. Nath and C.K. Chanda, "Basic Electrical Engineering", McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
5. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
6. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
7. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2017.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisites	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
ME 152	**Workshop practice**	**--**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	Explain the tools, equipment and safety procedures of carpentry, fitting, welding and foundry shops. (Understanding).		ME152.1	Utilize the tools and equipment to perform specified jobs in fitting shop and compare with prescribed dimensions.	Applying
			ME152.2	Utilize the tools and equipment to perform specified jobs in carpentry shop and compare with prescribed dimensions.	Applying
			ME152.3	Utilize the tools and equipment to perform specified jobs in welding shop and compare with prescribed dimensions.	Applying
			ME152.4	Utilize the casting process to develop the prescribed job	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO 3
ME152.1	2	1				2			2				2	1	
ME152.2	2	1				2			2				2	1	
ME152.3	2	1				2			2				2	1	
ME152.4	2	1				2			2				2	1	
ME152	**2**	**1**				**2**			**2**				**2**	**1**	

SYLLABUS

No.	Content	Hours	COs
I	To perform T-join with drilling in the centre in the fitting with the use of specific tools	**07**	**ME152.1**
II	To develop cross join/dovetail join/ briddle join in carpentry shop with the use of specific tools	**07**	**ME152.2**
III	To develop T-join Oxy-acetylene gas welding	**07**	**ME152.3**
IV	To make specific job using casting process	**07**	**ME152.4**
	Total Hours	**28**	

Essential Readings

1. S.K. Hajra Chaudhary, Elements of Workshop Technology Vol-I and II, Asia Publishing House, 2008

Supplementary Readings

1. K.N. Gupta, J. P. Kaushish, Workshop Technology, New Delhi Heights Publications, 1992
2. H.S. Bava, Workshop Technology, Tata McGraw Hill Publishing Co. Ltd., 2nd Edition, 2009
3. W.A.J. Chapman, Workshop Technology, ELBS Low Price Text, Edward Donald Pub. Ltd., 5th Edition, 1972

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS102	**Creativity, Innovation and Entrepreneurship**	**Nil**		**COs**	**Statement**				**Bloom's Taxonomy**	
Course Objectives	To introduce the basic aspects of creativity, innovation and entrepreneurship		Course Outcomes	HS102.1	Describe the basic concepts of creativity, innovation and entrepreneurship				Understand	
	To familiarize the importance of creativity, innovation, and entrepreneurship			HS102.2	Describe and illustrate the importance of creativity				Apply	
	To discuss the role and importance of creativity, innovation, and entrepreneurship for social development			HS102.3	Describe and illustrate the importance of innovation				Apply	
	To discuss the stages of the entrepreneurial process for the successful development of entrepreneurial projects			HS102.4	Describe and illustrate the importance of entrepreneurship				Apply	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
HS102.1	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.2	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.3	-	-	3	-	1	2	2	-	3	2	3	2			
HS102.4	-	-	3	-	1	2	2	-	3	2	3	2			
HS102	-	-	2.0	-	1.0	2.0	2.0	-	3.0	2.0	3.0	2.0			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of creativity, innovation, and entrepreneurship; Relation between creativity, innovation, and entrepreneurship; Differences between creativity and innovation; Differences between creativity and entrepreneurship; Differences between innovation and entrepreneurship; Event funding	06	HS102.1
II	Individual creativity, behaviour and psychological aspects of creativity; Idea generation; Creativity tools and techniques; Creativity in groups	06	HS102.2
III	Innovation and competitive advantage; Framework of innovative strategies; Organizational issues of innovation; Innovation in a competitive environment; Sources of innovation; Innovation selection; Effective implementation of innovative ideas	08	HS102.3
IV	Historical development of entrepreneurship; Types of entrepreneurship; Entrepreneurial opportunities; Entrepreneurial processes; Entrepreneurial strategies; Entrepreneurial practice; Sources of entrepreneurial ideas; Entrepreneurial project; Start-up; Contributions of entrepreneurs in society	08	HS102.4
	Total Hours	**28**	

Essential Readings

1. Pradip N. Khandwalla, *Lifelong Creativity: An Unending Quest*, Tata McGraw Hill, 2004.
2. Vinnie Jauhari and Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
3. Robert D. Hisrich et. al. *Entrepreneurship*, McGraw Hill Higher Education, 6th Edition, 2004.

Supplementary Readings

1. D. H. Holt, *Entrepreneurship: New Venture Creation*, Prentice Hall, 1992.
2. Lewrick, M., Link, P., and Leifer, L., *The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods,* John Wiley & Sons, 2020.
3. Hisrich, R. D., Peters, M. P., and Shepherd, D. A., *Entrepreneurship,* New York: McGraw-Hill, 2020.

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS152	**Python Programming**		**0**	**1**	**2**	**2**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce programming using Python and to write programs in python on a computer, and to edit, compile, debug, correct, recompile and run those.		CS152.1	**Able to understand the basic concepts of scripting and the contributions of scripting language.**	Understand
	To inculcate the ability to do algorithmic thinking to analyze real-world problems and develop algorithms to solve those.		CS152.2	**Able to develop Python programs with conditionals and loops, functions and calling them.**	Create
	To train the students in choosing right data representation formats based on a problem specification.		CS152.3	**Able to analyse and explore python data structures like Lists, Tuples, Sets and dictionaries.**	Analyze
			CS152.4	**Able to develop Python program to read and write data from/to files**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS152.1	3		1		1					1	1	1			
CS152.2	2	3	3	2	1				1					1	
CS152.3	3	3	3	2	1				1					3	
CS152.4	3	2	1	2										1	
CS152	2.75	2.67	2.00	2.00	1.00				1.00	1.00	1.00	1.00		1.67	

SYLLABUS

No.	Content	Hours	COs
I	1. Python program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. Python program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a + ab^2}{\sqrt{a^2+9}}$	**02**	**CS152.1** **CS152.2** **CS152.3** **CS152.4**
II	3. Python program to check a given number is odd or even and positive or negative. 4. Python program to read three numbers and find the greatest one.	**02**	
III	5. Python program to read five numbers and find the second smallest number. 6. Python program to find GCD and LCM of two numbers.	**02**	
IV	7. Python program to store ten numbers in a list and find the largest and smallest. 8. Python program to store N numbers in a list and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. Python program to check whether a given number is prime or not. 10. Python program to print first N numbers of Fibonacci series.	**02**	
VI	11. Python program to create a menu with the following options 1. TO PERFORM ADDITITON 2. TO PERFORM SUBTRACTION 3. TO PERFORM MULTIPICATION 4. TO PERFORM DIVISION Accepts users input and perform the operation accordingly. Use functions with arguments. 12. Python program to check whether the given string is palindrome or not.	**02**	
VII	13. Python program to find factorial of a given number using functions. 14. Python function that takes two lists and returns True if they are equal otherwise false	**04**	
VIII	15. Python program to open and write "hello world" into a file. 16. Python program to read a csv file using pandas module and print the first and last five lines of a file.	**04**	
IX	17. Python program to open a file and check what are the access permissions acquired by that file using os module. 18. Python program to copy the contents of a file to another file.	**04**	
X	19. Python program to count frequency of characters in a given file. 20. Python program to print each line of a file in reverse order.	**04**	
	Total Hours	**28**	

Essential Readings

1. Mark Lutz, " Programming Python", Prentice Hall India, 7th Edition, 2017
2. Mark Lutz, "Learning Python", McGraw-Hill publication, 6th Edition, 2021
3. Luciano Ramalho, "Fluent Python", O'Reilly Media, 2nd Edition, 2021

Supplementary Readings

1. Allen Downey, "Think Python", O'Reilly Media, 2nd Edition, 2015
2. Marl Pilgrim, "Dive into Python", APress Media LLC, 1st Edition, 2005
3. Brett Slatkin , "Effective Python: 59 Specific Ways to Write Better Python", Pearson Education, Inc, 2nd Edition 2019

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS104	**Ethics and Morals**	**Nil**								

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce the basic aspects of human values and ethics	Course Outcomes	HS104.1	Explain the basic aspects of ethics, values, and morals	Understand
	To familiarize a few ethical theories that guide human values and principles		HS104.2	Explain a few theories that guide ethics, values, and morals	Understand
	To discuss a multi-dimensional perspective of human values and ethics		HS104.3	Demonstrate a multi-dimensional perspective of human values and ethics	Apply
	To help in applying the concepts of ethics to personal ethical lifestyle choices and for community well-being		HS104.4	Apply the concepts of ethics to personal ethical lifestyle choices and decision making	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS104.1	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.2	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.3	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.4	-	-	2	-	-	3	2	3	1	1	1	-			
HS104	-	-	2.0	-	-	3.0	2.0	3.0	1.0	1.0	1.0	-			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of ethics, morals, and values; Differences between ethics, morals, and values; Types of ethics; Dimensions of ethics; Ethics in human actions; Role of family, society, and educational institutions in inculcating values	06	HS104.1
II	Theories on ethics; Egoism; Ethical ideologies; Moral development; Moral thinking; Values; Transparent standards; Fair competition; Equal opportunity; Conflict of interest; Code of conduct	08	HS104.2
III	Emotional intelligence and ethics; Corporate social responsibility and consumer protection; Environment ethics; Industry and environment management; Discrimination; Privacy; Surveillance; Coping with failures; Performance appraisals	07	HS104.3
IV	Relationship between attitude, thought and behaviour; Ethics and attitude; Social influence and persuasion; Ethical decision making; Personal values and ethical decision making; Trustworthiness; Respect; Responsibility; Fairness; Integrity	07	HS104.4
	Total Hours	**28**	

Essential Readings

1. R. R. Gaur, R. Sangal and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics*, Excel Books, 2010.
2. R. Subramanian, *Professional Ethics*, Oxford University Press, 2nd Edition, 2017.

Supplementary Readings

1. A. Carr, *Positive Psychology: The Science of Happiness and Human Strength*, Brunner-Routledge, 2004.
2. Charles E. Harris et.al. *Engineering Ethics: Concepts and Cases*, Wadsworth Publishing Co. Inc., 5th Edition, 2013.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
VA 102	**Skill Development and Prototyping**	**-----**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
To develop basic skills in the field of Electrical and Mechanical Engineering.		VA102.1	Students will be able to design domestic electric circuits and other basic circuits and function of different measuring instruments.	design
To make students familiar with different electrical, automobile, and plumbing instruments, setups, assembly, and tools.		VA102.2	Students will be able to understand the concept of battery charging/discharging systems and construction of machines, its starting, and fabrication of armature coil.	understand
To develop basic skills and understanding in 3-D printing technology		VA102.3	Students will be able to understand the functioning of different automobile parts and assemblies.	understand
		VA102.4	Students will be able to understand the functioning of different plumbing parts, tools, and assemblies.	understand
		VA102.5	Students will be able to understand the concepts of 3-D printing and its superiority over conventional manufacturing.	understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102.2	3	3	3	2	1	1			1		1	1	3	3	3
VA102.3	3	3	2	3	3	3	3		1		1	1	3	3	3
VA102.4	3	3	3	3	3	2	1		1		1	1	3	3	3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102	**3**	**3**	**2.75**	**2.5**	**2**	**2.25**	**2.33**		**1**		**1**	**1**	**3**	**3**	**2.75**

SYLLABUS

No.	Content	Hours	COs
I	**Electrical Shop:** Study and design different types of electrical wiring with loads, Study the cut- section of different types of AC/DC machines, Design and fabricate an armature coil using a handy coil winding machine, Assembling different parts of the electrical machine and testing its operation, Charging and discharging circuit of Batteries, Familiarization with analog /digital universal IC tester and advanced digital measuring instruments, To study the measurement of earth resistance using an earth tester, Energy measurement using a smart energy meter, Measurement of insulation resistance of cable/machine using insulation tester/megger, Starting of machine using various starters.	**6**	**VA102.1 VA102.2**
II	**Automobile Shop:** Demonstration on the cut section of the single and multicylinder engine (diesel and petrol), anti-lock braking system, constructional view and internal details of common automobile parts, fuel supply system of petrol and diesel engine, and coil ignition and electrical ignition system of an automobile.	**5**	**VA102.3**
III	**Plumbing Shop:** Demonstration on full-scale sewerage system, assembly station pipes, valves and fittings, tools for plumbing (plumbing wrenches, drain tools, and tools and supports for PVC pipes), cut away models of straightway valve, corner valve, angle seat valve, nonreturn valve, pressure reducing valve, strainer, gate valve, straightway plug valve, three ways plug valve, safety valve, screwed pipe connections, changeover valve, nonreturn butterfly valve, and strainer.	**4**	**VA102.4**
IV	**Additive Manufacturing Lab:** Introduction to 3-d printing, additive v/s conventional manufacturing, Engineering graphics, coordinate systems and their transformation, CAD, product design and prototyping, solid modeling and slicing software, STL files, additive manufacturing techniques, FDM printing, printing materials, support materials.	**5**	**VA102.5**
V	**Prototyping:** Circuit designing based on Electrical Shop, prototyping of automobile parts, plumbing tools, and parts, 3-D printing, etc.	**8**	**All COs**
	Total Hours	**28**	

Essential Readings

1. R.P. Singh, 'Electrical Workshop, Dreamtech Press, 3rd Edition, 2019
2. S.L. Uppal, "Electrical Wiring Estimating and Costing", Khanna Publishers, 6th Edition, 2015
3. K. Singh, "Automobile Engineering", Standard Publishers, 2020.
4. U. Rathore, N. K. Sharma, "A Textbook of Electrical Workshop Practices", S.K. Kataria & Sons, 1st Edition 2019
5. C.K. Chua, K. F. Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

Supplementary Readings

1. R.C. Mullin, P. Simmons, "Electrical Wiring Residential", Cengage Learning, 17th Edition, 2011.

2nd Year: Semester-3

B.Tech - Electrical and Electronics Engineering

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE201	**Electrical Machines I**	**No**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	Introducing basic features of Electrical Machines		EE201.1	Understand basic principle, laws, and mechanism of DC machines.	Knowledge, Comprehension
	Explanation of load performance of DC Machines		EE201.2	Analyse the construction, characteristics and application of various types of DC generators.	Knowledge, Analysis, Synthesis
	Study of speed control & testing of DC machines		EE201.3	Analyse the construction, characteristics and application of various types of DC motors.	Knowledge, Analysis, Synthesis
	Presenting basic performance details of Transformers		EE201.4	Understand the working of 1 phase transformer and different tests on the transformers	Comprehension, Application, Evaluation
	Imparting concept of multi-phase Transformers		EE201.5	Analyse the 3-phase transformer and conversion into to multi-phase transformers.	Comprehension, Analysis, Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE201.1	**3**	**3**	**2**	**2**	**1**	**2**	**1**					**2**			
EE201.2	**3**	**3**	**3**	**3**	**2**	**2**	**2**					**2**	**2**	**2**	**1**
EE201.3	**3**	**3**	**3**	**3**	**2**	**2**	**1**					**2**	**2**	**2**	**1**
EE201.4	**3**	**3**	**3**	**2**	**2**	**3**	**2**					**2**	**2**	**2**	**1**
EE201.5	**3**	**2**	**2**	**3**	**2**	**3**	**2**					**2**	**2**	**2**	
EE201	**3.00**	**2.80**	**2.60**	**2.60**	**1.80**	**2.40**	**1.60**					**2.00**	**2.00**	**2.00**	**1.00**

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Rotating Electrical Machines** General Constructional details for Rotating Electrical Machines, Electrical & Mechanical degree, Pole pitch & Coil pitch, Full-pitched coil & short-pitched coil; Pitch factor. Elementary view of rotating machines: Flux per pole, Generated EMF in full pitched coil, Generated EMF in a short-pitched coil, winding factor. Different types of torques in Electrical Machines; Physical concept of torque production. MMF waveform for commutator machines.	**12**	**CO1**
II	**DC Machine** Armature winding- types, designs, Lap and Wave winding. EMF equation Torque equation Armature reaction-cause, effect & remedial measures commutation-types, methods, effect on field flux distribution Methods for improving commutation. DC Generator: Methods of excitation, shunt, series and compound generators, open circuit characteristics, External Load characteristics DC motor: Speed torque characteristics Methods of starting & speed control. Losses and Efficiency of DC machines: Swinburne's test & Hopkinson's test.	**12**	**CO2, CO3**
III	**Transformers** Single Phase Transformers: Review of e.m.f equation and equivalent circuit, voltage regulation and efficiency, Determination of parameter from OC & SC tests, Back to Back test, parallel operation and load sharing, per-unit representation of transformer parameters. Auto Transformer: Principle of operation, Phasor diagram, Equivalent circuit and comparison with two winding transformer.	**12**	**CO4**
IV	**Three Phase Transformer** Construction of various types, operating characteristics of Star–Star, Star–Delta, Delta – star, Delta – Delta, Open – Delta and Zigzag connections, Vector Groups, Phase transformation, Three phase to Two phase, Three phase to Six phase, Three phase to Twelve phase transformation, Scott connection, parallel operation of Three phase transformer, Three winding transformers equivalent circuit and applications.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. A. Fitzgerald, C. Kingsley, S. Umans, Electric Machinery, TMH, New Delhi., 6th Edition,2013
2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 4th Edition,2015

Supplementary Readings

1. Say M. G., The performance and design of alternating current machines, CBS Publishers, Delh, 4 th Edition, 2004
2. Bimbhra P. S., Electrical Machinery, Khanna Pub., Delhi. 7th Edition, 2018
3. Clayton A. E., The performance and design of direct current machines, Pitman and sons, London. 4 th Edition, 1961
4. Bhag S. Guru, H. R. Hiziroglu, Electric Machinery and Transformers, Oxford, 4th Edition,2014

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 203	**Network Analysis**	**-**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- ❖ Teach the fundamentals of electrical circuits and their solving methods.
- ❖ Describe the concepts of network theorems and resonant circuits.
- ❖ Develop the ability and skills to solve circuits using Laplace and Fourier transforms.
- ❖ Cultivate the ability and skills to determine two-port network parameters.
- ❖ Introduce and explain the concepts of coupled circuits, graphs, trees, etc.

Course Outcomes

	CO's	**Statement**	**Bloom's Taxonomy**
	EE 203.1	Apply the knowledge of basic circuit law and various network reduction techniques for the analysis of electric and magnetically coupled circuits.	Knowledge, Identification & Application
	EE 203.2	Able to acquire and apply knowledge of circuit theorem (Superposition, Thevenin's, Norton's, and others) for electrical network with independent and dependent sources. Able to acquire and apply knowledge of resonance in RLC series and parallel circuits.	Knowledge, Identification & Application
	EE 203.3	Able to acquire and apply knowledge on Fourier series representation and RMS value computation of non-sinusoidal waveforms. Able to apply Laplace and Fourier transformations in evaluating various responses of electrical networks.	Knowledge & Application
	EE 203.4	Able to infer and evaluate transient response, steady-state response, network functions, and power relations in AC circuits.	Identification & Application
	EE 203.5	Able to acquire and apply knowledge on two-port networks and find the Z, Y, h, g, and ABCD parameters for different circuit configurations. Able to acquire and apply knowledge of graph theory about electrical circuits.	Knowledge Identification Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
EE203.1	**3**	**3**		**1**									**1**		**1**
EE203.2	**3**	**3**	**1**	**1**									**1**		**1**
EE203.3	**3**	**3**	**2**	**2**	**1**								**2**	**1**	**1**
EE203.4	**3**	**3**	**3**	**2**	**1**								**3**	**2**	**1**
EE203.5	**3**	**3**	**3**	**3**	**1**								**3**	**1**	**2**
EE 203	**3.00**	**3.00**	**2.25**	**1.80**	**1.00**								**2.00**	**1.30**	**1.40**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to electrical circuits:** Electrical Circuit and Network: Concept and Terminology, Classification of electrical networks, R-L-C Parameters, Voltage, and current sources, Independent and dependent sources, Source transformation, Voltage current relationship for passive elements, Kirchhoff's laws, Network reduction techniques, Parallel, Series-parallel, Star to Delta transformation, Nodal and Mesh analysis, and loop analysis.	**07**	**CO1**
II	**Network theorems:** Statement and proof: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Millman's theorem, Reciprocity theorem, and Tellegen's theorem under the dependent and independent sources for DC and AC excitation. **Resonance in AC circuits:** Characteristics and properties of resonance circuits, Series and parallel resonance circuits, Selectivity, Bandwidth and Quality factor.	**08**	**CO1, CO2**
III	**Laplace transform and Transient analysis:** Advantages of Laplace transform method, Definition and basic theorems of Laplace transform, Laplace transform of some basic functions and periodic functions, Inverse Laplace transform, Transient response of R-L, R-C, R-L-C networks using Laplace transform method with DC and AC excitation. Response to step, Impulse, and ramp inputs. **Coupled Circuits:** Concept of Self and Mutual inductance, Co-efficient of coupling, Dot convention, Analysis of multi-winding coupled circuits, Analysis of single tuned and double tuned coupled circuits	**09**	**CO3, CO4**
IV	**Two port networks:** Z, Y, ABCD, h-parameters, Conversion of one parameter to another parameter, Condition for reciprocity and symmetry, Two port network connections in series, parallel and cascaded. **Network topology:** Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and Loop currents, Cut-set matrix and node pair potentials, Duality and Dual networks.	**07**	**CO5**
V	**Fourier series & Fourier transforms:** Fourier series representation of non-sinusoidal waves, Discrete spectra, RMS values of non-sinusoidal waves, Steady-state response of linear circuits to non-sinusoidal waves, Power in such circuits, Applications to RL and RC circuits, Fourier transform of Signum and step functions.	**05**	**CO3, CO4**
	Total Hours	**36**	

Essential Readings

1. Franklin F. Kuo, "Network Analysis and Synthesis",John Wiley & Sons, Second Edition, 2006
2. M. E. Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt. Ltd., Third Edition, 2014.
3. D. Roy Choudhary, "Networks and Systems", Second Edition, New Age International, 2013.

Supplementary Readings

1. W. H. Hayt and J. E. Kemmerley, "Engineering Circuit Analysis", Tata McGraw Hill, Eighth Edition, 2013.
2. A. Chakrabarti, "Circuit Theory: Analysis and Synthesis", Sixth Edition, Dhanpat Rai& Co., 2014.
3. C. L. Wadhwa, "Network Analysis and Synthesis", New Age International Publishers, 2007

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE205	**Electrical and Electronic Measurements**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand how different measurement systems and their construction		EE205.1	Able to understand the concepts of different measurement systems, classification, and their properties	Remember Understanding
	To learn circuit design for different measuring systems		EE205.2	Able to identify errors and deviation in measurement systems	Understanding Apply
	To provide a student a knowledge to design and create novel products and solutions for real life problems.		EE205.3	Able to design bridge circuit for signal conditioning	Understanding Apply
			EE205.4	Able to apply CT and PT and energy meter	Apply Analyze
			EE205.5	Able to analyse display through Oscilloscope	Evaluate Analyze

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE205.1	**1**	**2**	**1**	**2**	**1**	**1**			**1**	**1**		**1**	**1**	**1**	**1**
EE205.2	**2**	**1**	**2**	**2**	**1**	**1**			**1**	**1**		**1**	**1**	**1**	**1**
EE205.3	**2**	**2**	**2**	**1**	**1**	**2**			**1**	**1**		**1**	**2**	**2**	**2**
EE205.4	**3**	**3**	**2**	**3**	**1**	**2**			**1**	**1**		**1**	**2**	**2**	**2**
EE205.5	**3**	**2**	**3**	**2**	**1**	**2**			**1**	**1**		**1**	**2**	**2**	**2**
EE205	**2.2**	**2.0**	**2.0**	**2.0**	**1**	**1.6**			**1**	**1**		**1**	**1.6**	**1.6**	**1.6**

SYLLABUS

No.	Content	Hours	COs
I	**Unit 1: Introduction to Measurement and Measurement Systems** Concept of measurement, measuring instruments, Classification of instruments, Basic measurement system, Static characteristics of instruments, Dynamic characteristics of instruments, Measurement system Errors, Statical analysis of data recorded in Measurement, Instrument calibration	**7**	**CO1**
II	**Unit 2: Errors During the Measurement Process** Sources of Systematic Error, Reduction of Systematic Errors, Quantification of Systematic Errors Statistical Analysis of Measurements Subject to Random Errors; Calibration of Measuring Sensors and Instruments: Principles of Calibration, Control of Calibration Environment, Calibration Chain and Traceability Calibration Records	**8**	**CO2**
III	**Unit 3: Analog Measuring Instruments** Construction and principle of operation of moving coil, electro-dynamometer, moving iron, Induction, and Electrostatic type indicating instruments. Deflecting, controlling and damping torques. Extension of instrument ranges using shunt, multipliers, Dynamic behavior of instrument and improvement of transient response. Principle of operation of the thermoelectric, rectifier type instruments.	**8**	**CO3**
IV	**Unit 4: Bridge Circuits Measurement of Resistance Inductance and Capacitance** General four arm bridge network, Kelvin's double bridge, Maxwell, Anderson, De-Sauty, Wien bridge, Schering bridge networks, Wagner earthling device.	**8**	**CO3**
V	**Unit 5: Instrument Transformers and Measurement of Energy** Theory of current and voltage transformer, Ratio error and Phase angle, Burden, turns compensation performance characteristics, testing and applications of CT and PT; Measurement of Energy: Single Phase Energymeter, Theory of single-phase induction type energy meter, three phase energymeter, Use of CT and PT in energy measurement, Basic concepts of Tariffs	**6**	**CO4**
VI	**Unit 6: Electronic Meters and Oscilloscope** Digital Meters, Analogue Meters; Oscilloscope: block diagram, CRT and its circuits, vertical deflection systems, delay line, multiple trace, horizontal deflection system, oscilloscope probes, sampling oscilloscope, storage oscilloscope	**7**	**CO5**
	Total Hours	**42**	

Essential Readings

1. A. K. Sawhney,"A course in Electrical & Electronic Measurements & Instruments", Dhanpat Rai and Co. Pvt. Ltd., 2015
2. Ernest O. Doebelin,"Measurement systems", Tata-McGraw Hill, 6th Edition, 2017
3. P Purkait, "Electrical & Electronics Measurements and Instrumentation" McGraw Hill Edu., 2017

Supplementary Readings

1. A. D. Heltrick &W.D. Cooper, "Modern Electronic Instrumentation & Measuring Instruments" PHI, 1992
2. S. K. Bhathcharya, "Electrical & Electronic Measurements and Instrumentation" Vikas Publishing House
3.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE207	**Analog Electronics Circuit**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the semiconductor materials and working principal for semi-conductor's devices to design diode and transistors circuits		EE207.1	Able to understand the concepts of semiconductor material, carrier formation, and diode properties and applications	Remember Understand
	To introduce the characteristics, specifications, IC specifications, open loop gain, negative feedback and gain computation in different configurations of operational amplifier.		EE207.2	Able to construct the semiconductor transistors BJT, JFET, MOSFET, and understand the characteristic for different circuits	Understand Evaluate
	To teach the frequency response analysis and different compensation network to obtain stability of Op-amp circuits. with the application of Op-amp circuits as active filters and oscillators.		EE207.3	Able to understand ideal operational amplifier, characteristics, biasing and offset analysis. Negative feedback in op-amp circuits. Inverting, and non-inverting configurations.	Understand Evaluate
	To analyze the applications of Op-amp circuit as active filters and oscillators.		EE207.4	Able to acquire knowledge on frequency response, Compensation and stability of Op-amp circuits with the application of Op-amp circuit as active filters and oscillators.	Understand Apply
	To design and analyze various linear and non-linear applications of Op-amp circuits.		EE207.5	Able to design and analyze some linear and non-linear applications of Op-amp.	Analyse Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE207.1	**2**	**2**	**2**	**2**	**1**	**1**			**1**				**1**	**1**	**1**
EE207.2	**2**	**3**	**3**	**3**	**2**	**1**			**1**				**2**	**2**	**2**
EE207.3	**2**	**2**		**2**	**3**				**1**				**3**	**2**	**3**
EE207.4	**2**	**2**		**2**	**3**				**1**			**1**	**3**	**2**	**3**
EE207.5	**2**	**2**		**2**	**2**	**2**			**1**			**1**	**3**	**2**	**3**
EE207	**2.00**	**2.20**	**2.50**	**2.20**	**2.2**	**1.3**			**1**			**1.00**	**2.40**	**1.8**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Unit 1: Fundamental of Analog Electronic Devices:** Solid state device fundamentals, BJT and FET configuration and analysis, bypass and coupling capacitors, biasing methods, stability, common base configuration analysis, emitter follower, common source amplifier, frequency response of BJT and FET amplifiers.	**9**	**CO1**
II	**Unit 2: Operational Amplifier** Introduction of op-amp, operational amplifier configuration, block diagram representation, schematic symbol, ICs and manufacturers designations, device identification, open-loop op-amp configuration, op-amp negative feedback, series-and-shunt configurations, difference amplifiers, offset analysis, common mode and differential mode gains, CMRR, compensating network, frequency response of compensated and non-compensated op-amp, slew rate, frequency response, GBW product, phase margin, biasing technique, error compensation	**9**	**CO2**
III	**Unit 3: Linear Applications** DC and AC amplifiers, peak amplifier, summing, scaling and averaging amplifiers, instrumentation amplifier, voltage-to-current converter, current-to-voltage converter, integrator and differentiator circuits	**8**	**CO3**
IV	**Unit 4: Filters and Oscillators** Active filters design, high order filter, low pass, band pass, high pass, and band reject filters, and all pass filter, oscillators, phase shift oscillator, and Wien bridge oscillators, quadrature oscillator, square, triangular and saw tooth wave generators, voltage controlled oscillator	**8**	**CO4**
V	**Unit 5: Comparators and Converters** Zero-crossing detector, schmitt trigger, voltage limiters and window detector, voltage-to-frequency and frequency-to-voltage converters, analog-to-digital and digital-to-analog converters, clippers clampers, peak detector, sample-and-hold circuit. The 555 timer, phase-locked loop, power amplifier, voltage regulators and application, audio function generator	**8**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Sedra and Smith, "Microelectronic Circuits", Oxford University Press, 5th Edition, 2004
2. Gayakwad Ramakant, "Op-Amps and Linear Integrated Circuits", PHI, 4th Edition, 2002.
3. Robert L. Boylestad, "Electronic Devices and Circuit Theory," Pearson, 10th Edition, 2009

Supplementary Readings

1. Jacob Millman and C. C. Halkias, "Integrated Electronics: Analog and Digital Circuits and Systems," McGraw-Hill Kogakusha, 2nd Edition, 2011.
2. P. Gray, P. Hurst, S. Lewis, and R. Meyer, "Analysis & Design of Analog Integrated Circuits," Wiley, 4th Edition, 2001.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE211	**Electrical Wiring and Earthing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To introduce wires, cables, terminations, and safety regulations in electrical systems.		EE211.1	**Able to acquire knowledge about wires, cables, terminations, and wiring accessories.**	Knowledge Identification Application
	To teach calibration of electrical measurement instruments.		EE211.2	**Able to acquire knowledge about various electrical measurement instruments and identification of application**	Knowledge Identification Application
	To develop skills in earthing techniques and ground testing.		EE211.3	**Able to identify and design earthing techniques and ground testing.**	Identification Design
	To develop skills in power conditioning, electrical estimation, and costing.		EE211.4	**Able to design advanced techniques in earthing and effectively conduct ground testing.**	Design
			EE211.5	**Able to design power conditioning systems, perform accurate electrical estimations**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE211.1	**3**	**1**	**2**	**1**	**2**	**1**	**1**	**1**				**1**	**3**		
EE211.2	**3**	**3**	**2**	**3**	**3**		**1**	**1**				**1**	**3**	**1**	**3**
EE211.3	**3**	**3**	**3**	**2**	**3**		**1**	**1**	**1**			**1**	**3**	**1**	**3**
EE211.4	**3**	**3**	**3**	**2**	**3**		**1**	**1**	**1**		**2**	**1**	**3**	**1**	**3**
EE211.5	**2**	**3**	**3**	**3**	**3**		**2**	**1**				**1**	**2**		**1**
EE211	2.8	2.6	2.6	2.2	2.8	1	1.2	1	1		2	1	2.8	1	2.5

SYLLABUS

No.	Content	Hours	COs
I	**Wires and Accessories** Wires, cables and their characteristics, Terminations and joints, Wiring accessories, Safety Considerations and Regulations	**06**	**CO1**
II	**Electrical Measurement Instruments** Multimeter: Analog Multi-meter, Digital Multi-meter; Tester: Tong Tester, Energy-meter, Megger, Earth resistance meter, Power Factor meter; Extension of range of measurement instruments: Voltmeter, Ammeter, Loading effect of voltmeter, Voltage drop effect of an ammeter; High Voltage Testing and Measurements; Calibration	**12**	**CO2**
III	**Earthing** Earthing and its importance: Basic considerations of earthing, Measurement of soil resistivity, Types of ground connections, Pipe Earthing, Plate Earthing, and Ground Testing.	**07**	**CO3**
IV	**Power Conditioning Appliances** Power Conditioning and its Importance, Different Power Conditioning Appliances: Battery, Inverter, Diesel Generator set, Stabilizer, UPS; Change over switch, Connection of water pump and geyser	**10**	**CO4**
V	**Electrical Estimation and Costing** Estimating and Costing Fundamentals; Estimation of Single and Three Phase Wiring: Steps for Estimation and Costing of Electrical Installations, Costing Calculations and Schedule of Rates; Estimation and Costing of House Wiring and Electrical Installations.	**07**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Maycock, W. P. (1899). Electric Wiring, Fittings, Switches, & Lamps: A Practical Book for Electric-light Engineers, Wiring and Fitting Contractors, Consulting Engineers, Architects, Builders, Wiremen, and Students. Whittaker & Company.

2. Steward, William E., and Tim A. Stubbs. Modern wiring practice. Routledge, 2005.

3. Chevalier, G., & Oschman, J. L. (2010). Understanding Earthing (Grounding). Can be downloaded from http://www.earthinginstitute. net/index. php/research.

Supplementary Readings

1. Switzer, W. Keith. "Practical guide to electrical grounding." An ERICO Publication First Printing (1999).

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE213	**Electromagnetic Field Theory**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the fundamental aspects of electromagnetism in electrical system.		EE213.1	Understand the different analysis method of electromagnetic fields	Knowledge Application
	To develop proficiency to analyse electromagnetic field distribution		EE213.2	Understand the electrical properties of materials in terms of electrostatics	Comprehension Synthesis
	To implement the concepts in practical applications.		EE213.3	Understand the magnetic properties of materials in terms of magnetostatics	Application Analysis
			EE213.4	Understand the phenomenon of fields under time varying condition.	Comprehension Evaluation
			EE213.5	Understand the wave propagation procedures and applications	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE213.1	**2**	**2**	**2**	**1**		**1**						**3**			**1**
EE213.2	**3**	**3**	**2**	**2**	**1**	**1**	**1**					**3**	**1**		**1**
EE213.3	**3**	**3**	**2**	**2**	**1**	**1**	**1**					**3**	**1**		**1**
EE213.4	**3**	**3**	**2**	**2**	**1**	**1**	**1**					**3**	**1**		**1**
EE213.5	**3**	**2**	**2**	**2**	**1**	**1**	**1**					**3**	**1**		**1**
EE213	**2.80**	**2.60**	**2.00**	**1.80**	**1.00**	**1.00**	**1.00**					**3.00**	**1.00**		**1.00**

SYLLABUS

No.	Content	Hours	COs
I	**Vector Analysis** Introduction to Electromagnetism; Basic laws of vector algebra; Orthogonal coordinate system and transformation; Vector Calculus; Gradient, Divergence & Curl operator; Divergence theorem & Strokes theorem; Laplacian operator; Classification of vector fields; Maxwell's Equations.	**08**	**CO1**
II	**Electrostatics** Coulomb's law and electric field intensity; Charge distributions; Maxwell's electrostatic equations; Gauss's law; Electric potential and Potential gradient; Electric dipole and concept of polarisation; Electrical properties of materials, conductors and dielectrics; Electrostatic Energy; Boundary conditions; Applications.	**08**	**CO2**
III	**Magnetostatics** Biot- savart law, Magnetic forces and torques; Maxwell's Magnetostatic equations; Ampere's circuit law; Magnetic vector & scalar potential, Magnetic dipole and concept of magnetisation; Magnetic properties of materials, Inductors; Magnetostatic Energy; Boundary conditions; Applications.	**08**	**CO3**
IV	**Time Varying Fields** Maxwell's equations for time varying fields; Faraday's law; Transformer and motional EMF; Displacement current; Time varying potential; Boundary conditions; Charge – Current continuity relation; Applications.	**08**	**CO4**
V	**Wave Propagation** Introduction to wave propagation; Classification of waves; Time Harmonic Fields; Complex permittivity; Plane wave propagation in free space, lossless dielectrics, lossy dielectrics and good conductors; Electromagnetic power density; Concept of transmission lines; Applications.	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. F. T. Ulaby, "Electromagnetics for Engineers", Pearson Education, 1st Edition, 2005.
2. Mathew N.O. Sadiku, "Principles of Electromagnetism", Oxford University Press, 6th Edition, 2015.

Supplementary Readings

3. Joseph A. Edminister, "Theory and problems of Electromagnetics", Tata McGraw Hill, 2nd Edition, 1992
4. Ashutosh Pramanik, "Electromagnetism- Theory and Applications", PHI, 2nd Edition, 2009.
5. N.N. Rao, "Elements of Engineering Electromagnetics", Pearson Education, 6th Edition, 2004.
6. W.H. Hayt & J.A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, 6th Edition, 2002.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE215	**Electronic Devices and Circuits**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To familiarize the student with the principal of operation, analysis and design of junction diode, BJT and FET transistors and amplifier circuits		EE215.1	Understand and Know the concepts of semiconductor theory	Knowledge Understand
	To understand diode as a rectifier		EE215.2	Analyze the Bipolar Junction Transistor characteristics and the biasing techniques	Understand Apply Analyze
	To study basic principle of filter of circuits and various types		EE215.3	Analyze the Field Effect Transistor characteristics and its applications	Understand Apply Analyze
			EE215.4	Design and analyze the Small Signal BJT Amplifiers	Analyze Create
			EE215.5	Design and analyze the Small Signal MOS and FET Amplifiers	Analyze Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE215.1	**3**	**3**	**3**	**3**	**1**	**3**			**2**				**1**	**1**	**1**
EE215.2	**3**	**3**	**2**	**3**	**1**	**3**			**2**				**1**	**1**	**1**
EE215.3	**2**	**2**	**2**	**2**	**1**	**3**			**2**				**2**	**2**	**2**
EE215.4	**2**	**2**	**2**	**2**	**1**	**2**			**2**				**2**	**2**	**2**
EE215.5	**2**	**2**	**2**	**2**	**1**	**2**			**2**				**2**	**2**	**2**
EE215	**2.4**	**2.4**	**2.2**	**2.4**	**1.0**	**2.6**			**2**				**1.6**	**1.6**	**1.6**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1: P-N Junction diode** Semiconductor characteristic, Diode circuits: P-N junction diode, I-V characteristics of a diode; resistance levels (static and dynamic), transition and diffusion capacitances, diode equivalent circuits, load line analysis, breakdown mechanisms in semiconductor diodes, review of half-wave and full-wave rectifiers, Zener diode characteristics, clamping and clipping circuits.	**9**	**CO1**
II	**Module 2: Bipolar Junction Transistor (BJT) circuits** Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; DC Biasing BJTS: Operating Point, Fixed-bias circuit, Emitter-Stabilized bais circuit, Voltage-Divider bias	**9**	**CO2**
III	**Module 3: Field Effect Transistor (FET) circuits** Construction and Characteristics of JFETs, Transfer Characteristics, MOSFET structure and I-V characteristics, Depletion-Type MOSFET, Enhancement-Type MOSFET, VMOS, CMOS; FET Biasing: Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing	**8**	**CO3**
IV	**Module 4: BJT Small Signal Analysis** Understanding BJT Transistor Modelling, Common-Emitter Fixed-Bias Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration, Emitter-Follower Configuration, Common-Base Configuration, Collector Feedback Configuration, Collector DC Feedback Configuration	**8**	**CO4**
V	**Module 4: FET Small Signal Analysis** FET Small signal model, JFET Fixed-Bias Configuration, JFET Self-Bias Configuration, FET Voltage-Divider Configuration, JFET Source-Follower (Common-Drain) Configuration, JFET Common-Gate Configuration	**8**	**CO4**
	Total Hours	**42**	

Essential Readings

1. A S Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press,
2. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S.,
3. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education,

Supplementary Readings

1. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press,
2. P.R. Gray, R.G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE217	**Microprocessor & Interfacing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To provide students with a comprehensive understanding of microprocessors and their architecture		EE217.1	Able to understand the basic structure of 8085A Microprocessor, architecture, buses, control signal, timing signal, memory mapping and input and output devices, tri-state, encoder, decoder and latch	Knowledge Understand
	To learn interface and programming skill		EE217.2	Interfacing of 8085 I/O, timing, peripheral and memory mapping	Understand Apply
	To make students learn architecture of microprocessor and programming skill		EE217.3	Acquire instruction set of 8085A for developing programming techniques	Understand Apply
	designing, programming, and interfacing microprocessor-based systems and be prepared for more advanced studies		EE217.4	Integrate data converters, display device, interrupt, timer, and other peripheral devices	Analyze Evaluate
	Develop skills for troubleshooting and debugging microprocessor-based systems and interfacing circuits.		EE217.5	Enhancing to 8086 architecture and related operation	Understand
	Explore various applications of microprocessors in real-world scenarios, including embedded systems, robotics, and automation.				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE217.1	**1**	**2**	**1**	**2**	**2**				**1**	**1**		**1**	**1**		
EE217.2	**2**	**1**	**1**	**2**	**2**	**1**			**1**	**1**		**1**	**2**	**1**	**1**
EE217.3	**2**	**1**	**1**	**1**			**1**		**1**	**1**		**1**	**2**	**3**	**3**
EE217.4	**1**	**1**	**1**	**1**	**1**	**1**			**1**	**1**		**1**	**2**	**3**	**3**
EE217.5	**1**	**2**	**3**	**2**	**2**	**2**			**1**	**1**		**1**	**2**	**1**	**1**
EE217	**1.4**	**1.4**	**1.4**	**1.6**	**1.75**	**1.33**	**1**		**1**	**1**		**1**	**1.8**	**2**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Unit 1: Microprocessor System** Introduction, concept of address and data buses, system control signals, basic bus timing, memory (RAM, ROM), memory mapping, input output devices: tri-state devices-buffer, decoder, encoder, and latch.	**06**	**CO1**
II	**Unit 2: 8085 Microprocessor** Introduction to 8085A, pin description, Architecture, bus timing and instruction timing, demultiplexing of buses, generation of control signals, memory interfacing, interrupts	**08**	**CO2**
III	**Unit 3: 8085 I/O Interfacing** Basic interfacing concepts, input/output timing, peripheral I/O interfacing and memory mapped I/O interfacing.	**07**	**CO3**
IV	**Unit 4: 8085 Programming** Instruction set of 8085A, addressing modes, programming, delay, stack and subroutine.	**07**	**CO3**
V	**Unit 5: Interfacing Peripherals** Interfacing concepts, data converters – ADC and DAC, 8255 programmable peripheral interface, 8279 programmable keyboard/Display, 8259A programmable interrupt controller, 8254 programmable interval timer	**08**	**CO4**
VI	**Unit 6: Introduction to 8086 Microprocessor** 8086 internal architecture, address generation, memory segmentation, minimum and maximum mode signal descriptions and basic timing.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. R. Gaonker, "Microprocessor Architecture, Programming & Application with 8085", Penram International.
2. K. M. Bhurchandi, A. K. Ray, "Advanced Microprocessors and Peripheral", Tata McGraw Hill.

Supplementary Readings

1. James L. Antonakos, "An introduction to the Intel family of Microprocessors", Pearson Education
2. B. Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai
3. A K. Mukhopadhyay, "Microprocessor, Microcomputer and their Applications", Narosa Publishing House

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 219	**Database Management Systems**	**---**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- ❖ To understand the fundamental concepts of database, operation of the relational data model, and its requirement in an organization.
- ❖ To understand the various relational data models, apply relational data models to design logical databases, including E-R diagrams and database normalization, and write simple and optimized advanced database queries using Structured Query Language (SQL).
- ❖ To develop the ability to design and implement a small database project using Structured Query Language (SQL).
- ❖ To understand the requirement of database tuning and the concept of database transaction management.
- ❖ Explore concurrent transactions and protocols for recovery from failures.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE 219.1	Able to describe the fundamental components of database systems, Relational Database Management System, and its need towards an organization.	Knowledge, Identification & Application
EE 219.2	Able to demonstrate the data models and analyze the real-world problems and requirements to give the appropriate solution using the principles of Entity Relationship Diagram.	Knowledge, & Identification
EE 219.3	Able to attain a practical understanding of SQL, convert the Entity-relationship model to relational tables, and operations to store the data using queries.	Knowledge & Application
EE 219.4	Able to apply the principles of normalization to remove redundancy and inconsistency and improve performance using database tuning and query optimization.	Identification & Application
EE 219.5	Able to understand the concurrent transactions, Problems such as failures, solutions to solve the concurrency problems & recovery from failure using protocols	Identification Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE203.1	**3**	**3**		**1**									**3**		**3**
EE203.2	**3**	**3**	**3**	**1**	**2**								**2**	**2**	**2**
EE203.3	**1**	**2**	**2**	**3**	**2**								**2**	**2**	**3**
EE203.4	**1**	**2**	**3**	**2**	**3**							**1**	**2**	**2**	**2**
EE203.5	**2**	**3**	**3**	**3**	**2**							**1**	**3**	**2**	**3**
EE 203	**2.00**	**2.60**	**2.75**	**2.00**	**1.80**							**1**	**2.40**	**2**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Database:** Purpose of database systems, data abstraction and modeling, instances and schemes, database manager, database users and their interactions, data definition and manipulation language, data dictionary, and overall system structure.	**04**	**CO1**
II	**Entity-relationship model:** Entities and entity sets, relationships and relationship sets, mapping constraints, E-R diagrams, primary keys, strong and weak entities, reducing E-R diagrams to tables, trees or graphs, generalization and specialization, aggregation.	**06**	**CO1, CO2**
III	**Brief Introduction to hierarchical and network model:** Data description and tree structure diagram for hierarchical model, retrieval and update facilities, limitations; Database task group (DBTG) model, record and set constructs retrieval and update facilities, limitations.	**06**	**CO2, CO3**
IV	**Relational model and Query optimization:** Structure of a relational database, operation on relations, relational algebra, tuple, and domain relational calculus, the salient feature of a query language, Structured query language: Description of an actual RDBMS and SQL. The importance of query processing, the equivalence of queries, cost estimation for processing a query, general strategies, bi-relational and multi-relational join algorithms, and algebraic manipulation.	**09**	**CO3, CO4**
V	**Normalization:** Pitfalls in RDBMS include the importance of normalization, functional, multi-valued, joint dependencies, 1NF to 5NF, and limitations of RDBMS. **Database tuning:** Index selection and clustering, tuning of conceptual schema, denormalization, tuning queries and views. **Crash recovery:** Failure classification, transactions, log maintenance, checkpoint implementation, shadow paging, and an example of an actual implementation.	**11**	**CO4, CO5**
	Total Hours	**36**	

Essential Readings

1. Silberschatz, Korth and Sudarshan, Database system concepts, McGraw Hill, 7th Edition, 2019.
2. C.J. Date, An Introduction to Database Systems (8th Edition), Pearson, 8th Edition, 2004.
3. Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming,", O'Reilly Media, 6th Edition, 2014.

Supplementary Readings

1. Elmasri and Navathe, Fundamentals of database systems; Pearson, 7th Edition, 2016.
2. Raghu Ramakrishnan and Gehrke, Database Management System, McGraw-Hill, 3rd Edition, 2014.
3. C. J. Date, SQL and Relational Theory: How to Write Accurate SQL Code, O'Reilly Media, 3rd Edition, 2015.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE271	**Renewable Energy Technology**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives

- **To provide understanding and application of various renewable energy sources.**
- **To introduce students with renewable energy resources availability, potential and suitability as a substitute for conventional energy resources in future energy demand.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE271.1	**Able to acquire knowledge of different types of renewable energy sources.**	Knowledge
EE271.2	**Able to understand solar PV technologies.**	Understand
EE271.3	**Able to understand wind energy conversion technologies.**	Understand
EE271.4	**Able to understand the concept of biomass conversion technologies.**	Understand
EE271.5	**Able to understand various renewable generation sources technologies and analyze their applications.**	Understand Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE271.1	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**				**1**	**3**		
EE271.2	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**1**				**1**	**3**		
EE271.3	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**1**				**1**	**3**		
EE271.4	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**1**				**1**	**3**		
EE271.5	**3**	**3**	**2**	**3**	**3**	**1**	**3**	**1**				**1**	**3**		
EE271	**3**	**3**	**2**	**2.8**	**2.8**	**1.8**	**2.8**	**1.2**				**1**	**3**		

SYLLABUS

No.	Content	Hours	COs
I	**Energy Sources & Availability** Conventional, non-conventional, renewable, non-renewable sources of energy, prospects, perspectives, & advantages. Introduction to different types of non-conventional sources of energy, renewable energy resources and their importance – Environmental aspects of energy utilization.	**05**	**CO1, CO5**
II	**Solar Energy** Availability of solar energy, Present and new technological developments in photovoltaic, estimation of solar irradiance, solar constant, solar radiation geometry, local solar time, day length, solar cell energy conversion, radiation on inclined surface, solar radiation data, & solar charts.	**05**	**CO2**
III	**Wind Energy** Wind as a source of energy, Characteristics of wind, wind data. Horizontal & vertical axis wind turbines, power conversion technologies.	**05**	**CO3**
IV	**Bio-Mass energy** Introduction to biomass, biofuels & their heat content, biomass conversion technologies. Aerobic & anaerobic digester, Factors affecting bio-digestion, biogas plants–types, description, utilisation of biogas, & use in I.C. engines. Biomass gasification: Gasifier types, direct thermal application of gasifiers. Advantages & problems in the development of gasifiers.	**06**	**CO4**
V	**Other Renewable Energy Technologies** Geothermal Energy, Hydrogen energy, Fuel Cells, Ocean Thermal Energy Conversion (OTEC), Tidal energy and Wave energy.	**07**	**CO5**
	Total Hours	**28**	

Essential Readings

1. Andrews J, Jelley N, "Energy Science", Oxford University Press, 2010
2. Fang Lin Luo, Hong Ye, "Renewable Energy Systems: Advanced Conversion Technologies and Applications", CRC Press, Taylor & Francis Group.
3. D.P. Kothari, Rakesh Ranjan and K.C. Singhal, "Renewable Energy Sources and Emerging Technologies", 2nd Edition, Prentice Hall India Learning Private Limited, 2011.
4. B H Khan, "Non-Conventional Energy Resources", Tata McGraw-Hill Education.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE281	**Electrical Safety and Standards**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce electrical safety and standards.		EE281.1	**Able to acquire knowledge about Electrical Safety Issues and identification of its application**	Knowledge Identification Application
	To teach grounding principles and safety measures.		EE281.2	**Able to acquire knowledge about General Requirements for Grounding and identification of application**	Knowledge Identification Application
	To develop ability and skill to design Electrical Safety Measures		EE281.3	**Able to identify the Electrical Safety Measures and Program Structures**	Identify, Design
	To develop ability and skill to design various Managing Safety in Electrical Systems		EE281.4	**Able to design Competence in the Safety Management of Electrical Systems**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE281.1	**3**	**2**	**2**	**1**	**1**							**3**	**3**	**1**	**1**
EE281.2	**3**	**2**	**2**	**1**	**2**							**2**	**3**	**1**	**1**
EE281.3	**3**	**3**	**2**	**2**	**3**		**2**	**1**	**1**		**1**	**1**	**3**	**2**	**1**
EE281.4	**3**	**3**	**3**	**2**	**3**		**1**	**1**	**1**		**3**	**1**	**3**	**1**	**3**
EE281	**3**	**2.5**	**2.25**	**1.5**	**2.25**		**1.5**	**1**	**1**		**2**	**1.75**	**3**	**1.25**	**1.5**

SYLLABUS

No.	Content	Hours	COs
I	**Electrical safety issues** Arc, blast, shocks-causes and effects-safety equipment- flash and thermal protection, head and eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers and signs, safety tags, locking devices- voltage measuring instruments- proximity and contact testers-safety electrical one-line diagram- electrician's safety kit	**05**	**CO1**
II	**General requirements for grounding** Definitions- grounding of electrical equipment, the purpose of system grounding, grounding electrode system, grounding conductor connection to electrodes of grounded circuit conductor for grounding equipment, grounding of low voltage and high voltage systems.	**07**	**CO2**
III	**Electrical safety measures and safety program structure** The six-step safety methods: pre-job briefings- hot -work decision tree-safe switching of power system lockout-tag out-flash hazard calculation and approach distances- calculating the required level of arc protection-safety equipment, procedure for low, medium, and high voltage systems- the one-minute safety audit Company safety team- safety policy- program implementation- employee electrical safety teams safety meetings- safety audit- accident prevention- first aid- rescue techniques-accident investigation	**09**	**CO3** **CO4**
IV	**Safety Management of Electrical Systems** Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, and Motivation to managers, supervisors, and employees. Review of IE Rules and Acts , their Significance: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and firefighting facility. The Electricity Act, 2003,	**07**	**CO4**
	Total Hours	**28**	

Essential Readings

1. Dennis Neitzel, Al Winfield,'Electrical Safety Handbook', McGraw-Hill Education, 4th Edition, 2012.
2. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978.
3. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.

Supplementary Readings

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE 251	**Electrical Machines-I Laboratory**	**NO**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- Introducing basic features of Electrical Machines
- Explanation of load performance of DC Machines
- Study of speed control & testing of DC machines
- Presenting basic performance details of Transformers
- Imparting concept of multi-phase Transformers

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE251.1	Analyse the construction, characteristics and application of various types of DC generators.	Knowledge, Analysis, Synthesis
EE251.2	Analyse the construction, characteristics and application of various types of DC motors.	Knowledge, Analysis, Synthesis
EE251.3	Understand the working of 1 phase transformer and different tests on the transformers	Comprehension, Application, Evaluation
EE251.4	Analyse the 3-phase transformer and conversion into to multi-phase transformers.	Comprehension, Analysis, Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE251.1	**3**	**3**	**3**	**3**	**2**	**2**	**2**					**2**	**2**	**2**	**1**
EE251.2	**3**	**3**	**3**	**3**	**2**	**2**	**1**					**2**	**2**	**2**	**1**
EE251.3	**3**	**3**	**3**	**2**	**2**	**3**	**2**					**2**	**2**	**2**	**1**
EE251.4	**3**	**2**	**2**	**3**	**2**	**3**	**2**					**2**	**2**	**2**	
EE251	**3.00**	**2.75**	**2.75**	**2.75**	**2.00**	**2.50**	**1.75**					**2.00**	**2.00**	**2.00**	**1.00**

SYLLABUS

No.	Content	Hours	COs
1	**Open circuit & external characteristics tests on DC shunt generator.**	**02**	**CO1**
2	**OCC test on DC compound generator (short- shunt).**	**02**	**CO1**
3	**Speed control of DC shunt motor.**	**02**	**CO2**
4	**Swinburne's Test on DC Machine.**	**02**	**CO2**
5	**Hopkinson's Test on DC Machines.**	**02**	**CO2**
6	**Load test on DC shunt motor.**	**02**	**CO2**
7	**Polarity Test on 1- phase Transformer.**	**02**	**CO3**
8	**Sumpner's Test on 1- phase Transformer.**	**02**	**CO3**
9	**Study of Scott connection for three –phase Transformers.**	**02**	**CO4**
10	**Study of different phasor groups for three –phase transformers.**	**02**	**CO4**
	Total Hours	**20**	

Essential Readings

1. A. Fitzgerald, C. Kingsley, S. Umans, Electric Machinery, TMH, New Delhi., 6th Edition,2013
2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 4th Edition,2015

Supplementary Readings

1. Say M. G., The performance and design of alternating current machines, CBS Publishers, Delh, 4 th Edition, 2004
2. Bimbhra P. S., Electrical Machinery, Khanna Pub., Delhi. 7th Edition, 2018
3. Clayton A. E., The performance and design of direct current machines, Pitman and sons, London. 4 th Edition, 1961
4. Bhag S. Guru, H. R. Hiziroglu, Electric Machinery and Transformers, Oxford, 4th Edition,2014

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE 253	**Network Analysis Lab**	**-lab**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	Understand and apply key network theorems in both DC and AC circuits.	Course Outcomes: EE 253.1	Understand the basic concept of basic electrical network-related problems and classifications.	Knowledge & Identification
	Analyze resonance in RLC series and parallel circuits to understand frequency response.	EE 253.2	Understand the power electrical networks the illustrative examples in the electrical networks.	Knowledge Identification Application
	Determine self-inductance, mutual-inductance, and coupling coefficients in transformers.	EE 253.3	Understand the Advantages, Definition, and basic theorems of the Laplace transform, Laplace transform of some essential functions and periodic functions, Inverse Laplace transform, and Transient response of R-L, R-C, RL-C networks using Laplace transform method with DC and AC excitation.	Knowledge & Application
	Observe and interpret transient responses in RL, RC, and RLC circuits with step inputs.	EE 253.4	Limitations Z, Y, ABCD, h-parameters and Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and Loop currents, Cut-set matrix and node pair potentials, Duality and Dual networks.	Knowledge & Application
	Measure and compute Z, h, Y, and ABCD parameters for two-port networks.	EE 253.5	Analyze the Fourier series representation of nonsinusoidal waves, Discrete spectra, RMS values of nonsinusoidal waves, and Steady-state response of linear circuits to non-sinusoidal waves.	Knowledge & Application
	Conduct experiments to reinforce and validate theoretical network analysis concepts.	EE 253.6	Understand the basic concept of the Fourier transform of signum and step functions.	Knowledge & Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE 253.1	**3**	**3**	**2**	**1**									**3**		**3**
EE 253.2	**3**	**3**	**1**	**1**					**1**				**3**	**1**	**2**
EE 253.3	**3**	**3**	**1**	**1**	**2**		**2**		**1**				**3**	**1**	**2**
EE 253.4	**3**	**3**	**1**		**2**	**2**	**2**		**1**			**1**	**3**	**1**	**2**
EE 253.5	**3**	**3**			**2**	**2**	**2**					**1**	**3**	**1**	**3**
EE 253.6	**3**	**3**			**2**								**3**	**1**	**3**
EE 253	**3.00**	**3.00**	**1.20**	**1.00**	**2.00**	**2.00**	**2.00**		**1.00**			**1.00**	**3.00**	**1.00**	**2.50**

SYLLABUS

No.	Content	Hours	COs
1	Verify principle of Superposition theorem with dc and ac sources.	**02**	**CO1** **CO2** **CO3** **CO4** **CO5** **CO6**
2	Verify Thevenin's and Norton's theorems in ac circuits.	**02**	
3	Verify Maximum Power Transfer theorem in ac circuits.	**02**	
4	Verify Reciprocity and Tellegen's theorems.	**02**	
5	Verify resonance phenomenon in RLC series circuit.	**02**	
6	Verify resonance phenomenon in RLC parallel circuit.	**02**	
7	Determination of self-inductance, mutual-inductance and coupling co-efficient of a single phase two winding transformer representing a coupled circuit.	**02**	
8	Observe the transient response of current in RL and RC circuits with step voltage input.	**02**	
9	Observe the transient response of current in RLC circuits with step voltage input for under-damp, critically damp and over-damp cases.	**02**	
10	Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters	**02**	
	Total Hours	**20**	

Essential Readings

1. W. H. Hayt and J. E. Kemmerley, "Engineering Circuit Analysis", Tata McGraw Hill, Eighth Edition, 2013.
2. M. E. Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt. Ltd., Third Edition, 2014.

Supplementary Readings

1. Donald E. Scott, "An Introduction to Circuit analysis: A System Approach", New edition McGraw Hill Inc., 1987.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE255	**Electrical and Electronic Measurements Lab**		**0**	**0**	**2**	**2**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	Able to calibrate different measuring and indicating instruments with better accuracy		EE255.1	Ability to apply the practical knowledge for calibrating different measuring instruments to measure various parameters	Knowledge Identification Application
	Able to measure Voltage, Current, Power factor, Power and Energy using different measuring instruments		EE255.2	Ability to utilize the Instrument Transformer and power measurement	Knowledge Identification Application
	Ability to balance AC Bridges to find unknown values		EE255.3	Ability to utilize Ammeter voltmeter, strain gauge	Knowledge Identification Application
			EE255.4	Ability to utilize bridge method	Knowledge Identification Application
			EE255.5	Ability to apply speed measurement	Knowledge Identification Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE255.1	**3**	**3**		**1**					**2**				**3**		**3**
EE255.2	**3**	**3**		**1**					**2**				**2**		**2**
EE255.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE255.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE255.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE255	**2.40**	**2.60**	**3.00**	**1.00**	**2.00**	**2.00**	**3.00**		**2.00**			**1.00**	**2.40**	**3.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
1	**Calibration of Energy meter.**	**03**	**CO1** **CO2** **CO3** **CO4** **CO5**
2	**Calibration of Wattmeter using potentiometer.**	**03**	
3	**To study the operation of the Instrument Transformer.**	**03**	
4	**Measurement of power in a 3-phase circuit by 2-wattmeter method.**	**03**	
5	**Calibration of MI ammeter and voltmeter using potentiometer.**	**03**	
6	**Displacement measurement using strain gauge.**	**03**	
7	**Resistance measurement using Kelvin double bridge.**	**03**	
8	**Capacitance measurement using Schering bridge.**	**03**	
9	**To determine unknown Capacitance and frequency using Wien's bridge.**	**03**	
10	**Speed measurement of a motor using an LED-based sensor.**	**03**	
	Total Hours	**30**	

Essential Readings

1. Sawhney A K : A course in Electrical & Electronic Measurements & Instruments; Dhanpat rai and sons.
2. Heltrick A.D. & Cooper W.D. : Modern Electronic Instrumentation & Measuring Instruments; Wheeler.
3. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill.
4. Ernest O. Doebelin: Measurement systems, Tata-McGraw Hill

Supplementary Readings

1. Wolf, Stanley, and Richard FM Smith. Student reference manual for electronic instrumentation laboratories. Pearson/Prentice Hall, 2004.

2nd Year: Semester-4

B.Tech - Electrical and Electronics Engineering

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE202	**Electrical Machines II**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	Introduction of basic features of AC machines	Course Outcomes	EE202.1	Understand characteristics of AC windings	Knowledge Application
	Explanation of operation, equivalent circuit of AC machines		EE202.2	Analyse the principle and characteristics of Three Phase Induction Machines	Comprehension Synthesis
	Study of speed control & testing of AC machines		EE202.3	Evaluate operation & equivalent circuit of single-phase induction machines	Application Analysis
	Presentation of working of special machines		EE202.4	Analyse Performance & operation of Synchronous Machines	Comprehension Evaluation
	Difference in construction & working in single and three phase ac machines		EE202.5	Understand basic working of special type of machines	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE202.1	**3**	**3**		**1**		**1**						**2**		**2**	
EE202.2	**3**	**3**		**1**	**1**	**1**	**2**					**3**	**3**	**1**	**1**
EE202.3	**2**	**3**	**3**	**1**	**1**	**2**	**2**					**3**	**3**	**1**	
EE202.4	**2**	**2**	**3**	**1**	**1**	**2**	**2**					**3**	**3**	**1**	**1**
EE202.5	**2**	**2**	**3**	**1**	**2**	**2**	**2**					**3**	**3**	**1**	**1**
EE202	**2.40**	**2.60**	**3.00**	**1.00**	**1.25**	**1.60**	**2.00**					**2.80**	**3.00**	**1.20**	**1.00**

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Rotating Electrical Machines** EMF polygon, Distribution factor, Pitch factor, Winding factor, MMF produced by a single coil & distributed winding, Determination of MMF waveform & magnitude for distributed windings; Open type armature winding for a.c machines; Development of single & double layer distributed windings; Clock diagram, Design of integral slot winding for ac machines with full-pitched & short-pitched coils, Production of Rotating Magnetic Field in ac machines.	**06**	**CO1**
II	**Poly-phase Induction Machines** Construction, principle of operation, slip, phasor diagram, equivalent circuits, expression for torque, and output power, slip torque characteristics, effect of variation of supply voltage and rotor resistance on the characteristics, circle diagram, predetermination of characteristics from the circuit diagram, drawing circle diagram from design parameters and no load and blocked rotor test data, starting of induction motors, direct on line starter, star-delta starter and autotransformer starter for cage induction motor, rotor resistance starter for slip ring induction motor, speed control of induction motor by varying supply voltage, supply frequency and pole changing, speed control of slip ring induction motor by rotor resistance.	**10**	**CO2**
III	**Single Phase Induction Motors** Principle of operation, double revolving field theory, equivalent circuit, performance calculations and characteristics, starting methods, maximum starting torque conditions.	**06**	**CO3**
IV	**Synchronous Machines** Construction, Types of Exciters, EMF equation, phasor diagrams for cylindrical rotor synchronous machines, armature reaction, open and short circuit characteristics, leakage reactance, synchronous reactance, phasor diagram under loaded conditions, load characteristics, predetermination of regulation by EMF and Potier triangle methods for non-salient pole alternators, steady state power flow equations, power angle characteristics, constant excitation and constant power output, two reaction theory for salient pole alternators and pre-determination for regulation, maximum power, slip test, V curves, inverted V curves, compounding curves for synchronous motors, synchronizing power, synchronizing torque, hunting phenomenon, starting of synchronous motor, synchronous condenser, Parallel Operation of Alternators: Synchronizing, Synchroscope, parallel operation of alternators, alternator on infinite bus-bar, effect of change of excitation and prime mover inputs.	**10**	**CO4**
V	**Special Machines** High torque induction motor, double cage and deep bar rotor construction, mains operated and self-excited induction generators, hysteresis motor, reluctance motor and stepper motor, brushless motors.	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. A. Fitzgerald, C. Kingsley, S. Umans, Electric Machinery, TMH, New Delhi., 6th Edition,2013
2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 4th Edition,2015

Supplementary Readings

3. Say M. G., The performance and design of alternating current machines, CBS Publishers, Delh, 4th Edition, 2004.
4. Bimbhra P. S., Electrical Machinery, Khanna Pub., Delhi. 7th Edition, 2018
5. Clayton A. E., The performance and design of direct current machines, Pitman and sons, London. 4th Edition, 1961
6. Bhag S. Guru, H. R. Hiziroglu, Electric Machinery and Transformers, Oxford, 4th Edition,2014

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 204	**Power System I**	**NIL**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To make the students familiar with generation, transmission & distribution of the electrical energy.		EE204.1	**Able to understand the general structure of generation, transmission, and distribution.**	Understand
	To understand the technical and economic aspects of the electrical systems.		EE204.2	**Able to analyse mechanical and electrical design aspects of overhead transmission lines.**	Analyse
			EE204.3	**Able to analyse and implement different transmission and distribution network models.**	Analyse, Implement
			EE204.4	**Able to understand the detailed constructions of underground cables and transients in power systems**	Understand
			EE204.5	**Able to understand the concept of tariff and evaluate the power factor improvement methods.**	Understand, Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE204.1	**3**	**3**	**2**	**1**	**2**		**1**					**1**	**3**		**1**
EE204.2	**3**	**3**	**3**	**2**	**2**		**1**	**1**				**1**	**3**		**1**
EE204.3	**3**	**3**	**3**	**2**	**1**			**1**				**1**	**3**		**1**
EE204.4	**3**	**3**	**3**	**1**								**1**	**3**		**1**
EE204.5	**3**	**3**	**2**	**1**	**1**			**1**				**1**	**2**		**1**
EE204	**3.00**	**3.00**	**2.6**	**1.4**	**1.2**		**0.4**	**0.6**				**1.00**	**2.8**		**1**

SYLLABUS

No.	Content	Hours	COs
I	**Generating Power Stations:** **Introduction of different types of power generation, Power scenario in India, Plant layout and operation of Thermal, Gas turbine based, Hydro-electric & Nuclear power plants, Renewable generations, Economics of Power generation, Tariff, Power factor and its effect on system economy, Power factor improvement, Deregulation.**	**05**	**CO1 CO5**
II	**Representation of Power System Network:** **Introduction and basic structure of power system, Single line diagram, different types of supply system and their comparison, High voltage transmission, Economic choice of voltage and conductor size, Introduction to Per Unit Quantities.**	**05**	**CO1 CO3**
III	**Distribution of Electric Power:** **Introduction, Structure, Types of D.C distributors, D.C distribution calculations, A.C distributor, fed at one and fed at both the ends with concentrated loads and uniformly distributed loads, ring distributors with interconnector, current distribution in three wire and four wire AC systems, overview of distribution automation.**	**07**	**CO1 CO3**
IV	**Mechanical Design of Overhead Lines:** **Introduction, Different components of overhead transmission lines, string efficiency, methods of improving string efficiency, Phenomenon of Corona, Corona loss, Introduction to sag and tension, Calculation of sag and tension, consideration of ice & wind loading, spacing and clearances.**	**06**	**CO2 CO3**
V	**Parameters of Transmission Lines:** **Introduction and basic theory, calculation of line resistance, inductance and capacitance for simple arrangements and multi-circuit lines, concept of self GMD and mutual GMD, bundled conductor, spacing of conductors, equivalent spacing, symmetrical and unsymmetrical spacing, transposition for single and double circuit, skin and proximity effects, Effect of earth on capacitance calculation.**	**07**	**CO2 CO3**
VI	**Characteristics and Performance of Transmission Lines:** **Introduction, Short and medium transmission lines, Charging currents, Calculation by nominal-T, nominal-π and end-condenser method, Regulation and efficiency, Concept of ABCD parameters, Ferranti effect, Modelling of long transmission line, Rigorous solution to long transmission line, evaluation of ABCD constants, interpretation of long line equation, Surge impedance and surge impedance loading, Equivalent circuit of a long transmission line, Power flow through a transmission line, Circle diagrams.**	**05**	**CO2 CO3**
VII	**Underground Cables:** **Introduction, cable construction, classification of cables, insulation resistance of a single core cable, capacitance and dielectric stresses in a single core cable, most economical conductor size in a cable, grading of cables, capacitance grading/Dielectric grading, inter-sheath grading, limitations of grading, Cable capacitance, charging or capacitive current, capacitance of three core cable and measurements of capacitances.**	**04**	**CO4**
VIII	**Transients in Power Systems:** **Introduction, Circuit closing transient, Sudden symmetrical short circuit of alternator, Recovery transient due to removal of short circuit, Travelling waves on transmission lines, Wave equations, Arcing grounds, Line design based on direct strokes, Surge arrestors Insulation coordination.**	**03**	**CO4**
	Total Hours	**42**	

Essential Readings

1. I.J Nagrath & D.P. Kothari, “Modern Power System Analysis”, Tata McGraw Hill, 4th Edition, 2011.
2. C.L. Wadhwa, “Electric Power System”, New Age International Publishers, 6th Edition, 2010.
3. W. D. Stevenson, “Element of Power System Analysis”, McGraw Hill, 4th Edition, 1982.
4. C.L Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International, 4th Edition, 2018.

Supplementary Readings

1. Ashfaq Hussain, “Electric Power Systems”, CBS Publisher & Distributors, 5th Edition, 2017.
2. Arun Ingole, “Power Transmission and Distribution”, Pearson, 1st Edition, 2018.
3. Luces m. Faulkenberry & Walter Coffer, “Electric Power Distribution and Transmission”, Pearson, 2nd Edition, 2007.
4. S.N. Singh, Electric Power Generation, Transmission and Distribution, Prentice Hall India Pvt., Limited, 2nd Edition 2008.
5. S.L Uppal & S. Rao, “Electrical Power Systems”, Khanna Publishers, 15th Edition, 2018.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE206	**Signals & Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To make students familiar with the Signals and Systems, and aware about the implications of the properties of signals and systems.	Course Outcomes	EE206.1	**Able** to understand the concepts of trigonometry, complex algebra, signal classification, system classification, operations on signals and system and their properties	Knowledge Understand
	To learn time domain and frequency domain analysis		EE206.2	**Select** the methods, processes, techniques for time domain evaluation i.e. convolution, correlation, response analysis	Knowledge Understand apply
	To learn the different frequency transform techniques		EE206.3	**Frequency** domain analysis of continuous-time signals and systems, properties and characteristics	Understand apply create
			EE206.4	**Integrate** transform strategies to analyze the signal more conveniently such as Laplace transform and z-transform	Analyze evaluate Apply
			EE206.5	**Employ** signal processing strategies, sampling, processing, signal construction	Apply Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE206.1	**1**	**2**	**1**	**2**	**1**	**1**			**1**	**1**		**1**	**1**	**1**	**1**
EE206.2	**2**	**1**	**2**	**2**	**1**	**1**			**1**	**1**		**1**	**1**	**1**	**1**
EE206.3	**2**	**2**	**2**	**1**	**1**	**2**			**1**	**1**		**1**	**2**	**2**	**2**
EE206.4	**3**	**3**	**2**	**3**	**1**	**2**			**1**	**1**		**1**	**2**	**2**	**2**
EE206.5	**3**	**2**	**3**	**2**	**1**	**2**			**1**	**1**		**1**	**2**	**2**	**2**
EE206	**2.20**	**2.0**	**2.0**	**2.0**	**1.0**	**1.6**			**1**	**1**		**1**	**1.6**	**1.6**	**1.6**

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Signals and Systems** Classification of Signals, Operation on Continuous Signals and Discrete Signals, Properties of Signals. Classification of Systems and Properties of Systems.	**7**	**CO1**
II	**Linear Time-Invariant System** Discrete-Time LTI Systems: The Convolution sum, Continuous-Time LTI systems: The Convolution Integral, Properties of LTI systems. Representation of Causal LTI using Differential and Difference equations. Convolution of Finite Sequences, Correlation.	**7**	**CO2**
III	**Frequency Analysis of Signal and Systems** Frequency Analysis of Continuous-Time Signals, Frequency Analysis of Discrete-Time Signals, Properties of The Fourier Transformation For Continuous- time and Discrete-Time (DTFT) Signals, Frequency-Domain Characteristics of LTI Systems.	**8**	**CO3**
IV	**Laplace Transform** The Laplace transform, Properties of the Laplace transforms, Inversion of the Laplace transform, Analysis of Linear-Time-Invariant Systems using Laplace transform.	**7**	**CO4**
V	**Z - Transform** The z-transformation, Properties of the Z-Transformations, Inversion of the z-transform, The One-Sided Z-transformation, Analysis of Linear-Time-Invariant Systems in the Z-Domain	**7**	**CO4**
VI	**Sampling** Sampling Theorems, Ideal Sampling, Impulse Sampling, Natural Sampling, Signal Reconstruction and Aliasing, Sampling of Band Pass Signal.	**6**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Oppenheim Alan V, Wilsky Alan S. and Nawab Hamid S, "Signal and Systems", Pearson Educations.
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education.
3. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing," PHI.
4. Tarun Kumar Rawat, "Digital Signal Processing," Oxford University Press, 2015.

Supplementary Readings

1. Lathi B. P, "Linear Systems and Signals", Oxford University Press.
2. Stuller John Alan, "An Introduction to Signal and Systems", Thomson India Edition.
3. Roberts M. J. and Govind Sharma, "Fundamental of Signals and Systems", Tata McGraw-Hill.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE208	**Digital Circuit Design**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To introduce fundamental about Boolean algebra & number systems		EE208.1	**Able to gain knowledge about Boolean algebra & number systems and their applications**	Knowledge Application
	To develop ability and skill to combinational and sequential logic circuits with simplest expression		EE208.2	**Able to obtain knowledge and to design combinational logic circuits with simplest expression**	Knowledge Design
	To introduce the fundamentals of Flip-Flops and their applications		EE208.3	**Able to understand the Flip-Flops and their applications**	Understand Application
	To develop ability and skill to design circuit of digital logic families		EE208.4	**Able to obtain knowledge and to design sequential logic circuits with simplest expression**	Knowledge Design
			EE208.5	**Able to design circuit of digital logic families**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE208.1	**3**	**3**		**1**					**2**			**1**	**3**	**2**	**3**
EE208.2	**3**	**3**	**2**	**1**	**2**				**2**			**1**	**2**	**2**	**2**
EE208.3	**3**	**3**	**3**	**2**	**2**	**2**	**2**						**2**	**3**	**3**
EE208.4	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE208.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE208	**2.6**	**2.6**	**2.75**	**1.5**	**2.0**	**2.0**	**2.67**		**2**			**1.0**	**2.4**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Boolean algebra & Number systems** Basic logic gates, Universality of NAND, NOR gates, AND-OR-Invert gates, Positive and Negative Logic; Boolean Algebra axioms and basic theorems; Standard and canonical representations of logic functions. Conversion between SOP and POS. Number systems-binary, Signed binary, Octal, hexadecimal number; Binary arithmetic, One's and two's complements arithmetic; Codes, Code converters;	**10**	**CO1**
II	**Combinational logic circuits** Simplification of logic functions, Karnaugh Map, Don't Care Conditions, Minimization using Entered Variable Map, Minimization using QM algorithm, Cost criteria, Minimization of multiple output functions. Adder, Subtractor, BCD arithmetic. Carry look ahead adder; Magnitude comparator, Multiplexer/Encoder; Demultiplexer/Decoder, BCD to 7-segment decoder driver, Priority encoder	**08**	**CO2**
III	**Flip-flops & Applications** Bistable latch, SR, D, JK, T Flip-Flops: level triggered, edge triggered, master – slave, Various representations of flip-flops; Analysis and synthesis of circuits that use flip-flop. Register, Shift register, Universal shift register; Application of shift register: ring counter, Johnson counter, sequence generator and detector, serial adder; Linear feedback shift register	**09**	**CO3**
III	**Sequential logic circuit design** Up and down counter, Ripple (asynchronous) counters, Synchronous counters; Counter design using flip flops, Counter design with asynchronous reset or preset; Applications of counters. Design of synchronous sequential circuit using Mealy and Moore models: state transition diagram, algorithm state machine (ASM) chart; State reduction technique. Digital to analog converters, Analog to digital converter	**09**	**CO4**
IV	**Digital logic families** Introduction; Relation between switching and logic operation; Use of Diode and Transistor as switch; Concept of noise margin, fanout, propagation delay; TTL, Schottky TTL, Tristate; CMOS Logic, Interfacing TTL with CMOS.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Donald P. Leach, Albert P. Malvino and Goutam Saha, "Digital Principles & Applications", 8th Edition, McGraw Hill.
2. M. Morris Mano and Michael D. Ciletti, "Digital Design" 5th Edition, Pearson.
3. Thomas L Floyd, R. P. Jain, "Digital Fundamentals", 9th Edition, Pearson.

Supplementary Readings

1. Taub and Shilling, "Digital Integrated Electronics", McGraw Hill.
2. Kime Charies R and Morris Mano, Logic and Computer Design Fundamentals, Pearson Education.
3. Mano Morris, Digital Logic and Computer Design, Pearson Education.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE212	**Measurement & Instrumentation**	**EE205**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
To understand the concepts of measuring instruments		EE212.1	Able to understand the basic operation of indicating and integrating instruments	Knowledge Understand
To learn and design electrical circuits for measurement systems		EE212.2	Select the methods, processes, techniques for measuring resistance, capacitance, and inductance	Understand Apply
To understand the circuit design in LabVIEW		EE212.3	Designing and testing of instrument transformers	Understand Apply Create
		EE212.4	Configuration and performance analysis of measurement system	Evaluate Create
		EE212.5	Employ different types of transducer as sensing element, electronic meters as measuring devices and oscilloscope as displaying devises	Evaluate Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE212.1	**2**	**2**	**1**	**2**	**2**				**1**	**1**		**1**	**1**		
EE212.2	**2**	**1**	**1**	**2**	**2**	**1**			**1**	**1**		**1**	**2**	**1**	**1**
EE212.3	**2**	**1**	**1**	**1**			**1**		**1**	**1**		**1**	**2**	**3**	**3**
EE212.4	**1**	**1**	**1**	**1**	**1**	**1**			**1**	**1**		**1**	**2**	**3**	**3**
EE212.5	**1**	**2**	**3**	**2**	**2**	**2**			**1**	**1**		**1**	**2**	**1**	**1**
EE212	**1.6**	**1.4**	**1.4**	**1.6**	**1.75**	**1.33**	**1**		**1**	**1**		**1**	**1.8**	**2.0**	**2.0**

SYLLABUS

No.	Content	Hours	COs
I	**Unit 1: Instrument Types and Performance Characteristics** Fundamentals of measurement systems; Review of Instrument Types: Active and Passive Instruments, Null-Type and Deflection-Type Instruments, Analogue and Digital Instruments, Indicating and Instruments with a Signal Output Instruments, Smart and Non-smart Instruments; Static Characteristics of Instruments: Accuracy and Inaccuracy, Precision/Repeatability/Reproducibility, Tolerance, Range or Span, Linearity, Sensitivity, Threshold, Resolution, Hysteresis effects Dead space; Dynamic Characteristics of Instruments: Zero-Order Instrument, First-Order Instrument, Second-Order Instrument, Necessity for Calibration	**07**	**CO1**
II	**Unit 2: Resistive, Capacitive, and Inductive Sensors** Potentiometer, Strain gages, Resistive Temperature Detectors (RTDs), Thermistors, Light-dependent Resistors (LDRs), capacitive sensors; variable capacitors differential capacitor; inductive sensors: variable reluctance sensors, eddy current sensors, linear variable differential transformers (LVDTs), Signal conditioning circuits: bridge methods, differential and Instrumentation amplifier	**07**	**CO2**
III	**Unit 3: Temperature and Pressure Measurement** Classification of sensors and transducers, Principle of temperature measurement, Thermoelectric effects Sensors (Thermocouples), Varying resistance devices, Semiconductor devices, Radiation thermometers, thermal expansion methods; pressure measurement: diaphragms, Capacitive pressure sensor. Fiber-optic sensors, bellows, bourdon tube, manometers, resonant-wire, dead-weight gauge	**08**	**CO3**
IV	**Unit 4: Mass Force, Torque and other Measurement** Mass measurement, Force measurement, Torque measurement, Flow measurement, Level measurement; Frequency measurement; Phase Measurement: Digital Counter/Timer, Phase-locked loop, Oscilloscope, Wein Bridge; Phase Measurement: Electronic Counter, X-Y Plotter, Oscilloscope, Phase-Sensitive Detector	**06**	**CO4**
V	**Unit 5: Motion Transducers** Translational motion transducers: displacement, velocity, acceleration, vibration, shock; Rotational motion transducers: Rotational displacement, rotational velocity, measurement of rotational acceleration	**07**	**CO5**
VI	**Unit 6: Signal Processing with LabVIEW** Data Acquisition with LabVIEW: Introduction to Graphical Programming in LabVIEW, Logic Operations in LabVIEW Loops in LabVIEW, Data Acquisition Using LabVIEW, LabVIEW Function Generation; Filters design in LabVIEW, Implementation on a breadboard	**07**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Sawhney A K : A course in Electrical & Electronic Measurements & Instruments; Dhanpat rai and sons
2. Heltrick A.D. & Cooper W.D. : Modern Electronic Instrumentation & Measuring Instruments; Wheeler.
3. D Patranabis: Principle of Industrial Instrumentation, Tata McGraw-Hill.
4. Ernest O. Doebelin: Measurement systems, Tata-McGraw Hill

Supplementary Readings

1. David A Bell: Electronic Instrumentation and measurement, Prentice Hall of India

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Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE214	**Principles of Communication Systems**	**----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To introduce the fundamentals of basic communication system, types of noise affecting communication system and noise parameters.**	EE214.1	**Able to understand different blocks in communication system and applications.**	Understand Application
	To teach the need of modulation, and different amplitude modulation schemes.	EE214.2	**Able to distinguish among different amplitude modulation schemes with their advantages and applications.**	Distinguish Application
	To introduce different angle modulation schemes with different generation and detection methods.	EE214.3	**Able to analyze generation and detection of FM signals & amplitude and angle modulation schemes.**	Analyze
	To develop ability and skill about sampling techniques.	EE214.4	**Able to design sampled and recovered original analog signals for different application.**	Design Application
	To develop ability and skill about generation and detection of pulse modulation techniques.	EE214.5	**Able to apply pulse modulation techniques.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE214.1	**3**	**3**	**2**	**1**					**2**				**3**	**2**	**3**
EE214.2	**3**	**3**	**2**	**1**					**2**				**2**	**2**	**2**
EE214.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**		**1**			**2**	**2**	**3**	**2**
EE214.4	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE214.5	**2**	**2**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE214	**2.4**	**2.6**	**2.6**	**1.2**	**2**	**2**	**2.67**		**1.8**			**1.33**	**2.6**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Basics-Energy and Power of Signals, Frequency Domain Representation, Discrete Fourier Series Example and Parseval's Theorem for Periodic Signals, Fourier Transform (FT), Inverse Fourier Transform (IFT) of Continuous Signals, Modulation Property of Fourier Transform, Dirac Delta or Unit Impulse Function, Linear Time Invariant (LTI) Systems, Transmission of Signal through LTI Systems, Auto-Correlation and Cross-Correlation of Signals and Energy Spectral Density (ESD), Communication Systems and noise parameters	**07**	**CO1**
II	**Amplitude Modulation (AM), Envelope Detection, Double Sideband Suppressed Carrier (DSB-SC)** Amplitude Modulation (AM), Modulation Index, Envelope Distortion and Over Modulation, Spectrum of AM Signals and Envelope Detection, Envelope Detection for AM Signals, Power and Power Efficiency of AM Signals, DSB-SC Modulation, Spectrum of DSB-SC Signals and Coherent Demodulation, DSB-SC Demodulation	**07**	**CO2**
III	**Costas Receiver, Quadrature Carrier Multiplexing (QCM) and Demodulation of QCM signals, Single Sideband (SSB) Modulation** Phase Synchronization using Costas Receiver for DSB-SC Demodulation, Quadrature Carrier Multiplexing (QCM) and Demodulation of QCM Signals, Single Sideband (SSB) Modulation, SSB Modulation Signals through Frequency Discrimination, Frequency Domain Description of Hilbert Transform, Phase Shifting Method for Generation of SSB Modulated Signals based on Hilbert Transform	**08**	**CO3**
IV	**Complex Pre-Envelope and Complex Envelope, Vestigial Side Band (VSB) Modulation, Phase Modulation (PM) and Frequency Modulation (FM)** Complex Pre-Envelope and Complex Envelope of Passband Signals and Quadrature Carrier Modulated (QCM) Signals, Vestigial Side Band (VSB) Modulation, Spectral Efficiency, VSB Filter for Reconstruction of Message Signal without Distortion, Angle Modulation, Phase Modulation (PM) and Frequency Modulation (FM), Insights of PM and FM signals, Indirect Method for Generation of FM Signals	**07**	**CO2** **CO3**
V	**Frequency Modulated (FM) Signals, Carsons Rule for FM Bandwidth, Narrowband FM Generation, FM Demodulation** Generation of FM Signals - Generation of Wideband FM Signal through Frequency Multiplication, Spectrum and Bandwidth of FM Signals - Carson's Rule, Demodulation of FM Signals, Condition of Envelope Detection, Analog to Digital Conversion of Signals, Sampling, Spectrum of Sampled Signal, Aliasing and Nyquist Sampling Theorem, Ideal Impulse Train Sampling, Reconstruction of Original Signal from Samples	**07**	**CO4**
VI	**Pulse Amplitude Modulation (PAM), Reconstruction, and Quantization** Pulse Amplitude Modulation (PAM), Sample and Hold, Flat Top Sampling, Spectrum of PAM Signal, Reconstruction of Original Signal from PAM Signal, Equalization, Quantization, Uniform Quantizer, Mid-Tread Quantizer, Mid-Rise Quantizer, PDF and Power of Quantization Noise, Lloyd-Max Quantization Algorithm, Optimal Quantizer Design	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Simon Haykin, Communication Systems, John Wiley & Sons (Asia) Pte Ltd, 3rd Edition,
2. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems (4/e); Oxford University Press, Oxford, 4th Edition,

Supplementary Readings

1. H. Taub and D. L. Schilling, Principles of Communication Systems, Tata McGrawHill, New Delhi, 2nd Edition
2. J. G. Proakis and M. Salehi, Communication System Engineering, Pearson Education (Singapore) Pte Ltd., 2nd Edition,

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Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE216	**Photonic Integrated Circuits**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce fundamentals of geometric optics**	Course Outcomes	EE216.1	**Able to acquire knowledge about geometric optics and its application**	Knowledge Application
	To introduce fundamentals of wave optics		EE216.2	**Able to acquire knowledge about wave optics and identify wave optics application**	Knowledge Application
	To teach principles of integrated optic waveguides.		EE216.3	**Able to acquire knowledge about integrated optic waveguides and identification of their application**	Knowledge Identification Application
	To develop skill to design photonic integrated circuits		EE216.4	**Able to explain photonic integrated circuit technology**	Explain
	To introduce optical resonators and wave propagation		EE216.5	**Able to utilize optical resonators and wave propagation in different applications**	Utilize

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE216.1	**3**	**3**		**1**					**2**				**3**	**2**	**3**
EE216.2	**3**	**3**	**2**	**1**	**2**				**2**				**2**	**2**	**3**
EE216.3	**3**	**3**	**3**	**1**	**2**	**2**	**3**						**3**	**3**	**2**
EE216.4	**2**	**2**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE216.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE216	**2.6**	**2.6**	**2.75**	**1.0**	**2.0**	**2.0**	**3.0**		**2.0**			**1.0**	**2.6**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Geometric Optics** Elementary geometrical optics in the paraxial approximation. Refractive index; reflection and refraction at a plane boundary from Huygens' principle and Fermat's principle; Snell's Law; total internal reflection. Image formation by reflection at a spherical boundary; concave and convex mirrors. Real and virtual images. Magnification. Image formation by refraction	**08**	**CO1**
II	**Wave Optics** Simple two-slit interference (restricted to slits of negligible width). The diffraction grating, conditions for proper illumination. The dispersion of a diffraction grating (The multiple-slit interference pattern and the resolution of a diffraction grating are excluded), Fraunhofer diffraction by a single slit, The resolution of a simple lens	**08**	**CO2**
III	**Principles** Photonics, Optical waveguide theory- Slab and Channel waveguides, Symmetric and Asymmetric waveguides, Analysis techniques: Effective index method, Marcatili's method, Numerical methods. Photonic waveguide components, Directional couplers, Coupled mode theory, tapers, bends, gratings, electro-optic, acousto-optic, magneto-optic devices, modulators, switches, polarizers, filters	**09**	**CO3**
IV	**Technology** Materials' glass, lithium niobate, silicon, compound semiconductors, polymers, fabrication's lithography, ion-exchange, deposition, diffusion, process and device characterization	**08**	**CO4**
V	**Optical Resonators and Wave Propagation** Optical resonators (Fabry Perot cavity, ring resonators, applications etc.), Wave propagation in periodic media (Bragg reflectors, photonic crystals and sub-wavelength structures), Micro-opto-electro-mechanical systems, Quantum Cryptography	**09**	**CO5**
Total Hours		**42**	

Essential Readings

1. E. Hecht and A. R. Ganesan, "Optics", Pearson Education India, 5th Edition, 2019.
2. C. R. Pollock and M. Lip Son, "Integrated Photonics", Kluwer Publication, 2003.
3. H. Nishihara, M. Haruna, and T. Suhara, "Optical Integrated Circuits", McGraw-Hill, 1988.

Supplementary Readings

1. Ajoy Ghatak, "Optics", McGraw Hill, 7th Edition, 2020.
2. T. Tamir (Editor), "Guided-wave optoelectronics", Springer-Verlag, 2nd Edition, 1990.
3. E. J. Murphy, (Editor), "Integrated Optical Circuits and Components: Design and Applications", Marcel and Dekker, 1999.

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 218	**Microcontroller and Embedded System**	**---**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	❖ To introduce 8051 microcontroller architecture.	Course Outcomes	EE 218.1	acquire knowledge about the features and architecture of the 8051 microcontrollers.	Knowledge, Identification & Application
	❖ To teach instruction sets, addressing mode, and programming for 8051.		EE 218.2	understand the programming and interfacing of the 8051 microcontrollers.	Knowledge, & Identification
	❖ To introduce the PIC family microcontroller.		EE 218.3	Describe the PIC family microcontroller's features, architecture, I/O ports, etc.	Knowledge & Application
	❖ To introduce an Embedded system and its architectures.		EE 218.4	define the architecture of the Embedded system.	Identification & Application
	❖ Explore advanced topics in embedded systems design, including interrupt handling, power management, memory management, and optimization techniques for efficient code execution and resource utilization.		EE 21.5	analyze real-time applications of Embedded systems.	Identification Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE218.1	**3**	**3**		**2**	**2**								**3**	**3**	**3**
EE218.2	**2**	**3**	**2**	**3**	**3**							**1**	**2**	**2**	**2**
EE218.3	**1**	**2**	**2**	**3**	**2**								**2**	**2**	**3**
EE218.4	**2**	**2**	**2**	**2**	**3**								**2**	**3**	**2**
EE218.5	**2**	**3**			**2**							**1**	**3**	**2**	**3**
EE 218	**2.00**	**2.60**	**2**	**2.50**	**2.40**							**1**	**2.40**	**2.40**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**8051 Microcontroller:** Features and Architecture Overview of the 8051 family, pin description, hardware connection, architectural overview, special function registers, memory organization, /O ports, interrupts, timer/counter, serial communication.	**07**	**CO1**
II	**8051 Programming and interfacing:** With Assembly and C Instruction set, addressing modes, I/O ports programming, interrupts programming, timer/counter-programming, serial communication programming, and interfacing external devices.	**07**	**CO2**
III	PIC16C6X-7X / PIC18F Family Microcontroller Introduction, features and overview on family, architecture, CPU registers, Oscillator connections, Stack, configuration registers, memory organization, I/O ports, hardware connection, interrupts, timers, watchdog timer, on-chip data converter module, Serial I/O. Introduction to dsPIC33F Family Digital Signal Controllers Introduction and overview, CPU, special MCU Features, data addressing overview, DSP engine, memory organization, interrupt and trap vectors, data address space, motor control PWM module.	**08**	**CO2, CO3**
IV	**Embedded System** Embedded systems introduction and description, design considerations & requirements, processors technology, IC technology, Embedded processors for embedded systems, power sources, high-performance architecture, and execution. Hardware and Software Architecture.	**08**	**CO4**
V	Concept of real-time systems, data communication in embedded systems, and real-time operating systems (RTOS). Embedded System Case Studies: Digital Thermometer, Smart cards, RF tags, Elevator.	**06**	**CO4, CO5**
	Total Hours	**36**	

Essential Readings

1. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay others, "The 8051 Microcontroller and Embedded Systems", Prentice Hall, 2nd Edition, 2005.
2. Ramesh Gaonkar, "Fundamental of microcontrollers and Applications in Embedded Systems", Thomson/Delmar Learning; 1 st Edition, 2007.
3. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware/Software Approach". Wiley India, 2nd Edition, 2001..

Supplementary Readings

1. Ajay V Deshmukh, "Microcontrollers: Theory and Applications", Tata McGraw-Hill, 5th Edition, 2011.
2. Richard H. Barnett, Larry O'Cull, Sarah Alison Cox, "Embedded C Programming and Microchip PIC", Cengage, 1st Edition, 2003.
3. Raj Kamal, "Embedded systems: Architecture, Programming and Design", Tata McGraw-Hill, 2nd Edition, 2008.

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Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE222	**Microelectronics**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To acquire fundamental knowledge semiconductor theory and its properties		EE222.1	Understand the concepts of semiconductor based BJT circuits, characteristics and the biasing techniques	Knowledge Understand
	To learn skills and design various semiconductor-based applications		EE222.2	Understand the concepts of semiconductor-based FET circuits, characteristics and the biasing techniques	Understand Apply Analyze
			EE222.3	Able to design different configuration of Opamp	Understand Apply Analyze
			EE222.4	Able to understand the feedback circuit	Analyze Create
			EE222.5	Able to design filters and its related circuits using opamp	Apply Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE222.1	**3**	**3**		**1**		**1**			**1**			**1**	**3**		**3**
EE222.2	**3**	**3**		**1**		**1**			**1**			**1**	**2**		**2**
EE222.3	**2**	**3**	**3**	**1**	**2**	**1**						**1**	**2**	**3**	**2**
EE222.4	**2**	**2**	**3**		**2**	**2**			**1**			**1**	**2**	**3**	**2**
EE222.5	**2**	**2**	**3**		**2**	**2**			**1**			**1**	**3**	**3**	**3**
EE222	**2.4**	**2.6**	**3**	**1**	**2**	**1.4**			**1**			**1**	**2.2**	**3.0**	**2.2**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1:** Bipolar Junction Transistor; Physical Structure and Modes of operation, Operation in Active Mode, circuit symbols and conventions, BJT as an Amplifier, small circuit model, BJT as a switch and Ebers Moll Model, Simple BJT inverter and Second Order Effects.	**08**	**CO1**
II	**Module 2:** MOS Transistor Basic, MOS Parasitic & SPICE Model; CMOS Inverter Basics-I, CMOS Inverter Basics, Power Analysis Biasing of MOS Amplifier and its behaviour as an analog switch, CMOS Amplifier Configuration, Internal cap models and high frequency modelling, JFET, structure and operation.	**08**	**CO2**
III	**Module 3:** S-domain analysis, transfer function, poles and zeros, High Frequency Response of CS and CE Amplifier, Frequency Response of CC and SF Configuration, Frequency Response of the Differential Amplifier, Cascade Connection and its Operation	**07**	**CO2**
IV	**Module 4:** General Feedback structure and properties of negative feedback, Basic Feedback Topologies, Design of Feedback Amplifier for all configuration, Stability and Amplifier poles, Bode Plots and Frequency Compensation	**07**	**CO3**
V	**Module 5:** Ideal Operational Amplifier and its terminals, Inverting and Non- Inverting Configuration, As an integrator and Differentiator, Introduction to Analog Computer, Large Signal Operation of Op-Amp and Second order offsets.	**06**	**CO4**
VI	**Module 6:** Butterworth and Chebyshev Filters, First and Second Order Filter Functions, Switched Capacitor based filters, Single-Amplifier Biquadratic Filters, Second Order LCR Resonator.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Rabaey, Chandrakasan and Nikolic, Digital Integrated Circuit A Design Perspective, PHI Latest Edition
2. Weste and Eshraghian, Principles of CMOS VLSI Design Addison Wesley, Latest Edition
3. Sedra and Smith, Microlectronics Circuits, Oxford University Press, 1998.

Supplementary Readings

1. B.G.Streetman and S. Banerjee, Solid State Electronic Devices, Prentice Hall

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE224	**Fundamentals of Aerospace Engineering**	**------**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the atmosphere and nomenclature aircraft components		EE224.1	**Able to acquire knowledge about aircraft atmosphere and components and their application**	Knowledge Application
	To teach the fundamentals of aircraft fluid mechanics		EE224.2	**Able to acquire knowledge about aircraft fluid mechanics and application**	Knowledge Application
	To develop fundamental skill about aerodynamics and propulsion		EE224.3	**Able to compute and design aerospace dynamics for propulsion**	Compute Design
	To develop ability and skill for aircraft performance and its dynamics		EE224.4	**Able to compute the performance dynamics**	Compute

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE224.1	**3**	**3**		**2**					**2**				**3**	**2**	**3**
EE224.2	**3**	**3**	**2**	**2**					**2**				**2**	**2**	**3**
EE224.3	**2**	**3**	**3**	**2**	**3**							**2**	**2**	**3**	**2**
EE224.4	**3**	**3**	**3**	**1**	**2**	**3**	**3**		**3**			**2**	**2**	**3**	**2**
EE224	**2.75**	**3**	**2.67**	**1.75**	**2.5**	**3**	**3**		**2.33**			**2**	**2.25**	**2.5**	**2.5**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Atmosphere & Nomenclature** Atmosphere and its properties: International Standard Atmosphere (ISA), Pressure, Temperature, Density and Viscosity Variation with Altitude in ISA, Other Standard Atmospheres. Nomenclature of aircraft components: Wing and its Components, Fuselage and its Components, Tail Plane and its Components	**07**	**CO1**
II	**Fluid Mechanics** Incompressible flow, Flow Visualization, Bernoulli's Equation, Coanda Effect, and Mach No., Viscous Flow, Boundary Layer, Pressure Measurement	**08**	**CO2**
III	**Aerodynamics & Propulsion** Airfoils, and Lift Generation Theories, Coefficient of Lift and Coefficient of Pressure, Critical Mach no., Types of Drag, Propulsion: Types of Aircraft Engines, Gas Turbine Engine Types, Introduction to Electric Propulsion and Ion Propulsion	**09**	**CO3**
IV	**Aircraft Performance** Steady Level Flight and Altitude effects, Glide, Climb, Ceilings, Turn, and Pull up, Aircraft Longitudinal Stability and V-n Diagram	**10**	**CO4**
V	**Performance Aerodynamics** Take-off and Landing Performance of Flight, Range, Specific Fuel Consumption and Generalized Range Equation, and Endurance, Range-Payload Diagram, Flapping Wing Aerodynamics	**08**	**CO3** **CO4**
	Total Hours	**42**	

Essential Readings

1. J. D. Anderson, Introduction to Flight, McGraw-Hill Professional, 2005
2. S. Eberhardt, D. Anderson, Understanding Flight. McGraw-Hill Publishing; 2009.
3. S. K. Ojha, Flight Performance of Aircraft, AIAA Education Series, 1995.

Supplementary Readings

2. M. Soler, Fundamentals of Aerospace Engineering: An Introductory Course to Aeronautical Engineering, Create Space Madrid, 2nd Edition, 2017.
3. J. D. Anderson, The Aeroplane, a History of its Technology, AIAA Education Series, 2002

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE272	**Energy Storage Systems**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		CO's	Statement	Bloom's Taxonomy
	Familiarize with various energy storage systems.		EE272.1	**Able to acquire knowledge of the scientific principles underpinning the operation of energy storage systems.**	Knowledge
	Design and model different types of energy storage systems.		EE272.2	**Able to understand the thermal storage system technology.**	Understand
	To learn how to design battery packs and analyse the operation.		EE272.3	**Able to understand the concept of chemical storage.**	Understand
			EE272.4	**Able to understand the electromagnetic and electrochemical storage systems**	Understand
			EE272.5	**Able to design battery packs for transportation.**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE272.1	**3**	**2**	**1**	**1**		**1**	**1**						**3**	**1**	**1**
EE272.2	**3**	**2**	**2**	**2**		**1**	**2**					**1**	**3**		**1**
EE272.3	**3**	**2**	**2**	**2**		**1**	**2**					**1**	**3**		**1**
EE272.4	**3**	**2**	**2**	**2**		**1**	**2**					**1**	**3**	**1**	**1**
EE272.5	**3**	**3**	**3**	**3**		**1**	**2**					**1**	**3**	**2**	**2**
EE272	**3**	**2.2**	**2**	**5**		**1**	**1.8**					**0.8**	**3**	**0.8**	**1.2**

SYLLABUS

No.	Content	Hours	COs
I	**Energy storage systems overview:** Scope of energy storage, needs, and opportunities in energy storage, Technology overview and key disciplines, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market.	**04**	**CO1**
II	**Thermal storage systems:** Heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies.	**05**	**CO2**
III	**Chemical storage systems:** Hydrogen, methane, concept of chemical storage of solar energy, application of chemical energy storage system, advantages, and limitations of chemical energy storage, challenges.	**04**	**CO3**
IV	**Electromagnetic storage systems:** Double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems, positive electrode materials, negative electrode materials, electrolytes.	**05**	**CO4**
V	**Electrochemical storage systems:** Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery. Working principle of supercapacitors, types of supercapacitors, difference between battery and supercapacitors, operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems.	**05**	**CO4**
VI	**Design of Batteries:** Battery design for transportation, Mechanical Design and Packaging of Battery Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Charging Optimization Methods, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles.	**05**	**CO5**
	Total Hours	**28**	

Essential Readings

1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press (2011).
2. Ralph Zito, Energy storage: A new approach, Wiley (2010).

Supplementary Readings

1. Pistoia, Gianfranco, and Boryann Liaw. Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost. Springer International Publishing AG, 2018.
2. Robert A. Huggins, Energy storage, Springer Science & Business Media (2010).

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Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
HS232	**Life Skills**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce an overview of life skills, stress coping mechanisms, and emotional management.		HS232.1	**Able to acquire knowledge about life skills and their application in personal and professional contexts.**	Knowledge
	To teach the significance of 21st-century skills such as creativity, critical thinking, collaboration, problem-solving, and decision-making, and their applications in professional settings.		HS232.2	**Able to demonstrate self-awareness by applying stress management techniques and coping strategies effectively.**	**Demonstrate Apply**
	To develop ability and skill to explore group and team dynamics, including the formation, management, and performance optimization of teams, both in physical and virtual environments.		HS232.3	**Able to apply creativity, critical thinking, collaboration, and problem-solving skills in various contexts.**	Apply
	To develop ability and skill to leadership frameworks, styles, and strategies for effective leadership development, including entrepreneurial and moral leadership, crisis management, and stakeholder management.		HS232.4	**Able to analyze and evaluate group and team dynamics, and propose strategies for management and performance improvement.**	Analyze
			HS232.5	**Able to integrate and synthesize leadership frameworks, styles, and strategies to effectively lead and manage teams in different organizational contexts.**	Integrate Synthesize

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS232.1												**3**			
HS232.2												**2**			
HS232.3												**3**			
HS232.4												**2**			
HS232.5												**3**			
HS232												**2.6**			

SYLLABUS

No.	Content	Hours	COs
I	**Overview of Life Skills** Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision-making, problem-solving, Effective communication, interpersonal relationships, coping with stress, coping with emotion. Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ	**04**	**CO1**
II	**Self-awareness** Definition, need for self-awareness; Coping with Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback. Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training, Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method, and relaxation techniques. Morals, Values, and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Cooperation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics	**08**	**CO2**
III	**21st-century skills** Creativity, Critical Thinking, Collaboration, Problem-Solving, Decision-making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence. Steps in problem-solving: Problem-Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking	**08**	**CO3**
IV	**Group and Team Dynamics** Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem-Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.	**04**	**CO4**
V	**Leadership** Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.	**04**	**CO5**
Total Hours		**28**	

Essential Readings

1. Shiv Khera, “You Can Win” , Macmillan Books, New York, 2003.
2. Barun K. Mitra, “Personality Development & Soft Skills”, Oxford Publishers, Third impression,2017.
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

Supplementary Readings

1. Caruso, D. R. and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership”, John Wiley & Sons, 2004.
2. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd.,2016
3. Larry James, “The First Book of Life Skills”; First Edition, Embassy Books, 2016.

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Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE 252	**Electrical Machines-II Laboratory**	**NO**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- Introduction of basic features of AC machines
- Explanation of operation, equivalent circuit of AC machines
- Study of speed control & testing of AC machines
- Presentation of working of special machines
- Difference in construction & working in single and three phase ac machines

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	EE252.1	Understand characteristics of AC windings	Knowledge Application
	EE252.2	Analyse the principle and characteristics of Three Phase Induction Machines	Comprehension Synthesis
	EE252.3	Evaluate operation & equivalent circuit of single-phase induction machines	Application Analysis
	EE252.4	Analyse Performance & operation of Synchronous Machines	Comprehension Evaluation
	EE252.5	Understand basic working of special type of machines	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE252.1	**3**	**3**		**1**		**1**						**2**		**2**	
EE252.2	**3**	**3**		**1**	**1**	**1**	**2**					**3**	**3**	**1**	**1**
EE252.3	**2**	**3**	**3**	**1**	**1**	**2**	**2**					**3**	**3**	**1**	
EE252.4	**2**	**2**	**3**	**1**	**1**	**2**	**2**					**3**	**3**	**1**	**1**
EE252.5	**2**	**2**	**3**	**1**	**2**	**2**	**2**					**3**	**3**	**1**	**1**
EE252	**2.40**	**2.60**	**3.00**	**1.00**	**1.25**	**1.60**	**2.00**					**2.80**	**3.00**	**1.20**	**1.00**

SYLLABUS

No.	Content	Hours	COs
1	**Study & design of distributed winding for the stator of 3-ph AC machine.**	**02**	**CO1**
2	**Study of different starting methods of 3-ph squirrel cage induction motor.**	**02**	**CO2**
3	**Performance of no -load & blocked rotor test of 3-ph induction motor and there from determine the rotational losses.**	**02**	**CO2**
4	**Speed control & Load Test of three phase Slip ring Induction Motor.**	**02**	**CO2**
5	**Load test of 1 phase induction motor and to draw the Performance Curves.**	**02**	**CO3**
6	**Determination of voltage regulation of 3-ph alternator by synchronous impedance method.**	**02**	**CO4**
7	**Determination of V & Inverted V curve for 3-ph synchronous motor.**	**02**	**CO4**
8	**Determination of voltage regulation of 3-ph alternator by ZPF method.**	**02**	**CO4**
9	**Characteristics of Synchronous Motor as Reactive Power Source and Sink.**	**02**	**CO4**
10	**Determination of speed torque characteristics of BLDC motor.**	**02**	**CO5**
	Total Hours	**20**	

Essential Readings

1. A. Fitzgerald, C. Kingsley, S. Umans, Electric Machinery, TMH, New Delhi., 6th Edition,2013
2. I. J. Nagrath, D.P. Kothari, Electric Machines, TMH, New Delhi, 4th Edition,2015

Supplementary Readings

1. Say M. G., The performance and design of alternating current machines, CBS Publishers, Delh, 4 th Edition, 2004
2. Bimbhra P. S., Electrical Machinery, Khanna Pub., Delhi. 7th Edition, 2018
3. Clayton A. E., The performance and design of direct current machines, Pitman and sons, London. 4 th Edition, 1961
4. Bhag S. Guru, H. R. Hiziroglu, Electric Machinery and Transformers, Oxford, 4th Edition,2014

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE254	**Power System - I Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To make the students familiar with the generation, transmission & distribution of the electrical energy.		EE254.1	**Able to analyze electrical distribution networks.**	Analyse
	To understand the technical and economic aspects of electrical systems.		EE254.2	**Able to compute and design different transmission models.**	Compute, Design
			EE254.3	**Able to implement and solve power system problems using MATLAB software.**	Implement

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE254.1	**3**	**3**	**2**	**3**	**1**		**1**	**1**				**1**	**3**		
EE254.2	**3**	**3**	**3**	**3**	**2**		**1**	**1**				**1**	**3**		**1**
EE254.3	**3**	**3**	**3**	**3**	**2**			**1**				**1**	**3**		**2**
EE254	**3.00**	**3.00**	**2.60**	**3.00**	**1.66**		**0.66**	**1.00**				**1.00**	**3.00**		**1**

SYLLABUS

No.	Content	Hours	COs
1	**To analyse DC distributor (I) fed at only one end and (II) fed at both the end by the feeders.**	**2**	**CO1** **CO2** **CO3**
2	**To design and study DC three wire distribution system**	**2**	
3	**To design and analyse Ring main distribution system**	**2**	
4	**To write a Matlab Program for Corona Loss calculation.**	**2**	
5	**Determination of A, B, C, D parameters, voltage regulation and efficiency of a short/long transmission line model.**	**2**	
6	**To find out A, B, C, D parameters, voltage regulation and efficiency of a T and PI transmission line model.**	**2**	
7	**To determine surge impedance loading (SIL) of 220 kV transmission network.**	**2**	
8	**To perform NO load test and observe the Ferranti effect.**	**2**	
9	**To perform load test and calculate regulation, and efficiency of medium transmission line.**	**2**	
10	**Voltage regulation using Shunt reactor/shunt capacitor for T/PI transmission networks**	**2**	
11	**Voltage regulation using VAR compensator for T/PI transmission networks**	**2**	
12	**To study and analyze HVDC transmission networks (Monopolar & Bipolar)**	**2**	
	Total Hours	**24**	

Essential Readings

1. I.J Nagrath & D.P. Kothari, "Modern Power System Analysis", Tata McGraw Hill, 4th Edition, 2011.
2. C.L. Wadhwa, "Electric Power System", New Age International Publishers, 6th Edition, 2010.
3. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill, 4th Edition, 1982.
4. C.L Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International, 4th Edition, 2018.

Supplementary Readings

1. Ashfaq Hussain, "Electric Power Systems", CBS Publisher & Distributors, 5th Edition, 2017.
2. Arun Ingole, "Power Transmission and Distribution", Pearson, 1st Edition, 2018.
3. Luces m. Faulkenberry & Walter Coffer, "Electric Power Distribution and Transmission", Pearson, 2nd Edition, 2007.
4. S.N. Singh, Electric Power Generation, Transmission and Distribution, Prentice Hall India Pvt., Limited, 2nd Edition 2008.
5. S.L Uppal & S.Rao, "Electrical Power Systems", Khanna Publishers, 15th Edition, 2018

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Department	**Electrical Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE256	**Signals & Systems Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives	
To familiarize withe MALTAB software, and its applicability
To learn different symbols and functions in MATLAB software
To learn coding in MATLAB for different applications
To learn Simulink design in MATLAB for different applications

Course Outcomes	CO's	Statement	Bloom's Taxonomy
	EE256.1	Understand the basics operation of MATLAB	Knowledge Understand
	EE256.2	Analysis the time domain and frequency domain signals.	Understand Application
	EE256.3	Implement the concept of Fourier series and Fourier transforms.	Understand Application
	EE256.4	Find the stability of system using pole-zero diagrams, bode diagram and frequency response	Understand Application
	EE256.5	Able to design system function in Simulink	Understand Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE256.1	**3**			**3**	**2**				**1**	**1**		**2**	**2**	**3**	**2**
EE256.2	**3**	**2**	**1**						**2**	**2**		**2**	**2**	**3**	**2**
EE256.3	**2**	**2**	**2**		**2**				**1**	**1**		**1**	**2**	**3**	**2**
EE256.4	**2**	**1**	**2**	**2**	**1**				**1**	**1**		**2**	**1**	**3**	**2**
EE256.5	**1**	**2**	**3**	**2**	**1**				**1**	**1**		**2**	**2**	**3**	**2**
EE256	**2.2**	**1.4**	**1.6**	**1.6**	**1.2**				**1.2**	**1.2**		**1.8**	**2.40**	**3.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
1	**Introduction to MATLAB** To learn variables, functions, vectors and matrices, arithmetic operators, and mathematical functions, to create and use m-files, to study various MATLAB commands. Write a MATLAB program to plot the following continuous time and discrete time signals: Step Function, Impulse Function, Exponential Function, Ramp Function and Sine Function	**02**	**CO1** **CO2** **CO3** **CO4** **CO5**
2	**Time and Amplitude transformations** Write a MATLAB program to perform amplitude-scaling, time-scaling and time shifting on a given signal.	**02**	
3	**Convolution of given signals** Write MATLAB code to compute linear convolution and circular convolution of $x(n)$ and $h(n)$ and give comments on each step. Compare your results using MATLAB functions. Draw the flow chat of your linear convolution algorithm.	**02**	
4	**Autocorrelation and Cross-correlation** Write MATLAB code to compute auto-correlation and cross-correlation of $x(n)$ and $h(n)$ and give comments on each step. Compare your results using MATLAB functions. Draw the flow chat of your auto-correlation algorithm.	**02**	
5	**Fourier Transform** To calculate Fourier series coefficients associated with different waves. Write MATLAB code to compute DFT and FFT algorithm of $x(n)$ give comments on each step. Compare your results using MATLAB functions. Draw the flow chat of your DFT algorithm.	**02**	
6	**Calculating transforms using MATLAB** Calculate and plot Fourier transform of a given signal. b. Calculate and plot Z-transform of a given signal.	**02**	
7	**Impulse response and Step response of a given system** Write a MATLAB program to find the impulse response and step response of a system form its difference equation. b. Compute and plot the response of a given system to a given input.	**02**	
8	**Pole-zero diagram and bode diagram** Write a MATLAB program to find pole-zero diagram, bode diagram of a given system from the given system function. b. Write a MATLAB program to find, bode diagram of a given system from the given system function.	**02**	
9	**Frequency response Analysis** Write a MATLAB program to plot magnitude and phase response of a given system	**02**	
10	**System design in SIMULINK** Realize the given function in the different structures in MATLAB Simulink. Considering appropriate coefficients, plot the frequency response.	**02**	
	Total Hours	**20**	

Essential Readings

1. Amos Gilat, "MATLAB An introduction with Application" John Wiley & Sons inc. 2010
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education.
3. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing," PHI.
4. Tarun Kumar Rawat, "Digital Signal Processing," Oxford University Press, 2015.

Supplementary Readings

1. Roberts M. J. and Govind Sharma, "Fundamental of Signals and Systems", Tata McGraw-Hill.

3rd Year: Semester-5

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE301	**Power System II**	**EE202**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- **To understand the economics of power system operation and perform load flow analysis.**
- **To develop the ability and skill to analyse power system faults and stability.**
- **To understand the requirements and methods of real and reactive power control in power systems.**
- **To realize optimal scheduling of hydro-thermal generation.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE301.1	**Able to acquire knowledge about the operation of large power systems and understand the stability issues.**	Knowledge Understand
EE301.2	**Able to analyse load flow of power system and compute faults in the transmission network.**	Analyse Compute
EE301.3	**Able to compute fault current and analyse its sequence components in the transmission network.**	Compute, Analyze
EE301.4	**Able to understand the frequency and voltage control mechanism of power systems and perform economic load dispatch.**	Understand
EE301.5	**Able to understand and design the unit commitment problem considering various constraints and perform hydro-thermal generation scheduling.**	Understand, Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE301.1	**3**	**3**	**2**	**2**	**2**		**1**	**1**				**1**	**3**		
EE301.2	**3**	**3**	**3**	**3**	**3**		**1**	**1**				**1**	**3**		**3**
EE301.3	**3**	**3**	**3**	**3**	**3**			**1**				**1**	**3**		**3**
EE301.4	**3**	**3**	**3**	**3**	**3**		**2**	**1**				**1**	**3**		**3**
EE301.5	**3**	**3**	**3**	**3**	**3**		**2**	**1**				**1**	**2**		**3**
EE301	**3**	**3**	**2.8**	**2.8**	**2.8**		**1.5**	**1**				**1**	**2.8**		**3**

SYLLABUS

No.	Content	Hours	COs
I	**Representation of Power System** Introduction, single phase solution of balanced three phase networks, one line diagram and impedance or reactance diagram, per-unit (p.u.) system, complex power, synchronous machine, representation of loads, construction of bus matrices.	**04**	**CO1**
II	**Power Flow Formulation** Network model formulation, Formation of Y bus, Power flow problem, Different types of buses, Approximate power flow, Gauss Seidel method, Newton-Raphson method, Decoupled Power flow studies, Fast Decoupled power flow studies, Comparison of power flow methods.	**05**	**CO2**
III	**Fault Analysis** Introduction, transient on a transmission line, short circuit of a synchronous machine on no load and, balanced three phase fault analysis using bus impedance matrix, selection of protective equipment's, Symmetrical component transformation, construction of sequence networks of power systems, Symmetrical component analysis of unsymmetrical faults, single line to ground (LG) fault, line to line (LL) fault, double line to ground (LLG) fault, open conductor faults, bus impedance matrix method for analysis of unsymmetrical faults.	**07**	**CO3**
IV	**Power System Stability** Introduction to stability, dynamics of a synchronous machine, power angle equation, power angle curve, simple systems, steady state stability, transient stability, equal area criteria, numerical solution of swing equation, some factors affecting transient stability.	**06**	**CO1**
V	**Economic Dispatch** Economic dispatch without line losses, Economic dispatch with line losses, Lambda iteration method, Gradient method, Newton's method, Base point and participation factors, Transmission losses, Co-ordination equations, Incremental losses, Penalty factors, B matrix loss formula (without derivation), and Methods of calculating penalty factors including losses.	**06**	**CO4**
VI	**Active Power and Voltage Control** Introduction to real and reactive power control loop, Automatic voltage regulator, Load frequency control, Droop Characteristics, Single area system, Bias Control, Telemeter measurements, multi-area system, Tie line control, static and dynamic analysis.	**06**	**CO4**
VII	**Generation Scheduling** Hydrothermal co-ordination, Scheduling energy, short term hydrothermal scheduling, Lambda-gamma iteration method, Gradient method, Cascaded hydro plants, Pumped storage hydro scheduling.	**04**	**CO5**
VIII	**Unit Commitment** Constraints in unit commitment, Priority list method, Dynamic programming method and Lagrange relaxation methods.	**04**	**CO5**
	Total Hours	**42**	

Essential Readings

1. I.J Nagrath & D.P. Kothari, "Modern Power System Analysis", Tata McGraw Hill, 4th Edition, 2011.
2. O.I. Elgerd, "Electrical Energy System Theory: An introduction", 2nd Edition, 1983, TMH.
3. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill, 4th Edition, 1982.
4. P Kundur, "Power System Stability and Control", Tata McGraw-Hill, 1st Edition, 2006.

Supplementary Readings

1. Hadi Saadat, "Power System Analysis", McGraw Hill, 1st Edition, 1991
2. S. Sivanagaraju & G. Sreenivasan, "Power System Operations & Control", Pearson, 1st Edition, 2009
3. G. W. Stagg and A. H. EI-Abaid, "Computer Methods in Power System Analysis", McGraw Hill, 1st edition, 1971
4. C.L. Wadhwa, "Electric Power System", New Age International Publishers, 6th Edition, 2010.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE303	**Power Electronics**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To understand the operation of different power electronic switches and their applications
- To know about on load operation of converters
- To understand control strategies of converter operation
- To perform steady state analysis of different converters

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE303.1	Understand the operation of different power electronics switches and their usage for different applications	Knowledge Application
EE303.2	Design power electronics converters to convert the ac supply into dc	Comprehension Synthesis
EE303.3	Design power electronics converters to convert fixed dc supply into variable dc	Application Analysis
EE303.4	Design power electronics converters to convert dc supply into ac	Comprehension Evaluation
EE303.5	Design power electronics converters to convert fixed ac supply into variable ac supply	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE303.1	**3**	**1**	**2**	**1**		**1**						**2**			
EE303.2	**3**	**3**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE303.3	**3**	**3**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE303.4	**3**	**3**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE303.5	**3**	**2**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE303	**3.00**	**2.40**	**2.80**	**1.00**	**2.00**	**1.00**	**1.00**					**2.80**	**3.00**	**2.00**	**1.00**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Power Electronics Scope and Applications, Interdisciplinary Nature of Power Electronics, Types of power electronics circuits, Introduction to power electronic devices like Thyristor (SCR), Power BJT, Power MOSFET, GTO, IGBT, Thyristor Characteristics, Two transistor analogy, Gate Characteristics, Methods of triggering and commutation, Ratings and protection of devices, Series and parallel operation of thyristor, Protection of dv/dt & di/dt for semiconductor switches	**06**	**CO1**
II	**Phase Controlled Rectifiers / AC-DC Converter** Principle of phase control, half wave controlled rectifiers, half wave controlled rectifiers with R, R-L, R-L with Freewheeling Diode, R-L-E load, single phase full wave controlled converters, 2-pulse mid-point converters, 2- pulse half and fully controlled bridge converters with R, R-L, R-L-E load, Three phase converter system with diodes, 3 phase half and fully controlled bridge converters, triggering scheme, Effect of source impedance on the performance or the converters, Dual converters.	**10**	**CO2**
III	**Choppers / DC-DC Converter** Basic principle of chopper operation, Different methods of classification, Control strategies – Duty Ratio Control and Frequency Control, Types of idealized chopper circuit, Steady state time domain analysis of Class - A choppers, Thyristor Chopper Circuits.	**08**	**CO3**
IV	**Inverters / DC-AC Converter** Voltage Source Inverter (VSI)- Single phase voltage source inverters, Half bridge inverters, full bridge inverters, Steady state analysis, Voltage control in single phase inverters, 3-phase bridge inverters; 180º mode VSI, 120º mode VSI, Pulse Width Modulated (PWM) inverters; single pulse, multiple pulse, sinusoidal pulse modulation, Current Source Inverter (CSI), Series and parallel inverter, Reduction of harmonics in output voltage, Control of output voltage.	**10**	**CO4**
V	**Cyclo-converter / AC-AC Converter** Principle of AC Voltage Controllers – Integral Cycle Control and Phase Control, Types of AC voltage controllers, Analysis of 1-phase & 3-phase voltage controllers with R and R-L load. Principle of operation of cyclo-converters, circulating and non circulating mode of operation, single phase to single phase step up and step down Cyclo-converters, three phase to single phase Cyclo-converters, three phase to three phase Cyclo-Converter .	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. M. H Rashid, "Power Electronics Circuits, Devices, and Applications", Prentice-Hall of India Pvt. Ltd, 3rd Edition, 2014
2. L. Umanand, "Power Electronics Essential and Applications", Willey, 1st Edition, 2009.

Supplementary Readings

3. P. S. Bimbhra, "Power Electronics", Khanna Publishers, 5th edition, 1990.
4. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill Publishing Co. Ltd, 2nd Edition, 2006
5. M. Ned and T. M. Undeland, "Power Electronics Converters Applications and Design", John Willey Inc, 3rd Edition, 2002.
6. J. P. Agrawal, "Power Electronic Systems: Theory and Design", Addison Wesley Longman Pte. Ltd, 1st Edition, 2001.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE305	**Linear Control Systems**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the basic concepts, elements and terminologies of control systems**	Course Outcomes	EE305.1	**acquire knowledge about the control systems, compensators, and their applications.**	Knowledge, Application
	To model and discuss different physical systems (plants) in Laplace and state-space frameworks.		EE305.2	**define the mathematical models of dynamic systems in transfer function and state-space forms.**	Define
	To study the performance and stability of LTI systems in time and frequency domains.		EE305.3	**analyse and define the LTI system performance and stability in both time-domain and frequency domain.**	Define, Analyse
	To discuss and design compensators/ controllers using analytical and graphical techniques.		EE305.4	**compute the Root locus and design the appropriate compensator using Root locus technique.**	Compute, Design
			EE305.5	**compute Bode, Nyquist plots and design the appropriate compensator using Bode plot technique.**	Compute, Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE305.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE305.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE305.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
EE305.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE305.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE305	**2.0**	**2.4**	**2.6**	**2.25**	**2.0**	**1.8**	**1.6**		**2.0**			**2.0**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Basic Concepts** Basic definition, Basic elements of control system, Open loop control system, Closed loop control system, Control system terminology, Manually and Automatic controlled closed loop systems, Basic elements of a servo mechanism, Analogous systems: Electrical analogous system of multidisciplinary discipline, Notion of Feedback.	**05**	**CO1**
II	**Modelling and Representations of Control Systems** Ordinary differential equations, Derivation of transfer functions of physical systems, Block diagram representation of physical systems, Signal flow graphs, Conversion of block diagram to signal flow graph, Block diagram reduction technique, Signal flow graph manipulation using Mason's gain formula. State-Space representation of physical systems.	**07**	**CO2**
III	**LTI System Performance in Time and Frequency Domains** Standard test signals, significance of impulse response, Transient analysis of zero, first and second order systems and determination of different time domain performance specification, Steady state error analysis for Type-0, Type-1 and Type-2 systems, Static and dynamic errors coefficients, and errors criteria, Frequency response analysis of first and second order systems, Link between time and frequency domain response, Effect of addition of poles and zeros on system time response.	**10**	**CO1** **CO3**
IV	**Stability of LTI Systems** Fundamental concepts of LTI system stability, Definitions of stability: BIBO stability, Zero-Input stability, Absolute stability, Relative stability, Asymptotic stability etc., Determination of closed loop control system stability from characteristic equation: Routh stability criterion, Hurwitz stability criterion.	**06**	**CO1** **CO3**
V	**Graphical Techniques for Measurement of System's Relative Stability** The Root-Locus concepts, Construction of Root Locus, Root contour, Frequency domain techniques: Bode-plot, Polar-plot, Nyquist plot, Nyquist Stability Criterion for open loop stable and unstable systems, Concept of Gain Margin, Phase Margin, Closed loop frequency response.	**08**	**CO4** **CO5**
VI	**Compensator Design LTI Systems** Introduction, Different types of compensators, Design of lag, lead, lag-lead compensators using root locus and Bode diagrams, Design of PI, PD and PID controllers by analytical method, frequency response method and root locus technique.	**06**	**CO4** **CO5**
	Total Hours	**42**	

Essential Readings

1. K. Ogata, "Modern Control Engineering", PHI.
2. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International.
3. N. S. Nise, "Control System Engineering", Wiley India.

Supplementary Readings

1. R. C. Dorf, R. H. Bishop, "Modern Control Systems", Pearson Education.
2. B. C. Kuo, "Automatic Control Systems", Wiley India.

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Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE311	**Restructured Power Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- **To familiarize the students with concepts and the need for deregulated power systems.**
- **To impart the knowledge of power market development, operation, and energy transactions.**
- **To understand the flexibility of ancillary service and congestion management.**

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	EE311.1	**Able to understand the fundamental reasons and motivations behind the global restructuring of the energy sector.**	Understand
	EE311.2	**Able to understand the roles and responsibilities of different entities in the electricity market.**	Understand
	EE311.3	**Able to analyse congestion management problems and design methods for transmission pricing, and ancillary services.**	Analyse, Design
	EE311.4	**Able to understand the Power market scenarios in India.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE311.1	**2**	**1**	**1**										**2**		**1**
EE311.2	**2**	**1**	**2**	**1**	**1**			**1**					**2**		**1**
EE311.3	**2**	**2**	**2**	**1**	**1**	**1**		**1**					**2**		**1**
EE311.4	**1**		**1**		**1**			**1**					**2**		**1**
EE311	**1.75**	**1**	**1.5**	**0.5**	**0.75**	**0.25**		**0.75**					**2**		**1**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to restructuring of power industry:** Deregulation of power industry, unbundling of electric utilities, Issues involved in deregulation, Deregulation of various power systems –Fundamentals of Economics: Consumer behaviour, Supplier behaviour, Market equilibrium, short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Market Mechanism.	**09**	**CO1**
II	**Power System Operation in Competitive Environment** Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: GENCOs in Pool and Bilateral markets, market participation issues, competitive bidding.	**08**	**CO1 CO2**
III	**Transmission congestion management:** Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management –Classification of congestion management methods –Calculation of ATC -Non –market methods – Market methods –Nodal pricing –Inter zonal and Intra zonal congestion management –Price area congestion management – Capacity alleviation method.	**08**	**CO3**
IV	**Ancillary service management and pricing of transmission network:** Introduction of ancillary services –Types of Ancillary services –Classification of Ancillary services –Load generation balancing related services –Voltage control and reactive power support devices –Black start capability service -ancillary service –Co-optimization of energy and reserve services -International comparison - Transmission pricing –Principles –Classification – Role in transmission pricing methods –Marginal transmission pricing paradigm –Composite pricing paradigm –Merits and demerits of different paradigm.	**09**	**CO2 CO3**
V	**Power market development in India:** Institutional structure in the Indian Power sector, generation, transmission, and distribution utilities. SO& LDCs. PFC, REC, ERCs, traders, Power Exchanges, and their roles. Availability-based tariff, Open access, Industry structure and regulatory framework, market development, RE policies, RPO, Tariff policies. Policy changes, regulatory changes, Critical issues/challenges before the Indian power sector.	**08**	**CO1 CO4**
	Total Hours	**42**	

Essential Readings

1. Lorrin Philipson, H. Lee Willis, "Understanding Electric Utilities and De-Regulation", CRC Press, 2nd edition, 2005.
2. Kankar Bhattacharya, Jaap E. Daadler and Math H.J. Boolen, "Operation of restructured power systems", Springer, 1st edition, 2001.
3. Loi Lei Lai, Power system Restructuring and Deregulation: Trading, Performance and Information Technology, John Wiley & Sons, Pvt. Ltd., 1st edition, 2001.

Supplementary Readings

1. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 1st edition, 2002.
2. Mohammad Shahidehpour and Muwaffaq Alomoush, "Restructured electrical power systems: operation, trading and volatility", CRC Press; 1st edition, 2017.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE313	**Power System Transients**		3	0	0	3	50	50	100	200

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To the concept of transients in electrical circuits.		EE313.1	Able to acquire knowledge about electrical transients and identification of its application	Knowledge Identification Application
	To teach the mechanisms and impacts of switching transients in power systems.		EE313.2	Able to acquire knowledge about switching transients and their effects and identification of application.	Knowledge Identification Application
	To develop the ability and skill to coordinate and protect insulation against lightning transients.		EE313.3	Able to identify the lightning transients and coordinate insulation level	Compute, Design
	To develop skills for protecting equipment against transient overvoltage.		EE313.4	Able to design of protect equipment against transient overvoltages:	Design
			EE313.5	Able to model and analyze power equipment behavior under transient conditions	Model Analyze

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE313.1	3	3		1					2				3		3
EE313.2	3	3		1					2				2		2
EE313.3	2	3	3	1	2								2	3	2
EE313.4	2	2	3		2	2	3		2			1	2	3	2
EE313.5	2	2	3		2	2	3		2			1	3	3	3
EE313.6															
EE313	2.40	2.60	3.00	1.00	2.00	2.00	3.00		2.00			1.00	2.40	3.00	2.40

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Transients** Introduction to simple transients in R-L, R-C, RLC Circuit, Origin and nature of power system transient and surges, Equivalent circuit representations, Lumped and distributed circuit parameters, Switching and Lightning overvoltage.	04	CO1
II	**Switching Transients in Power Systems** Resistance switching, Capacitance switching, current chopping in circuit breakers, load switching, Transformer, magnetizing Inrush Currents, Shortline fault condition.	08	CO2
III	**Lightening Transients and Insulation Coordination** The Mechanism of Lightning, Wave-shape of the Lightning Current, Direct and Indirect Lightning Stroke, Interaction between lightning and power system, Basic concept of insulation coordination and insulation level, Statistical approach to insulation coordination, Correlation between insulation and protection levels	12	CO3
IV	**Protection of Equipment against Transient Overvoltage** Protection of transmission lines against lightning, Surge suppressors and lightning arrestors, Surge capacitor and reactor, Surge protection of rotating machines, Transient voltages and grounding practice	09	CO4
V	**Modeling and Behavior of Power Equipment under Transient Condition** Modeling of transformer, overhead transmission lines, cables, generators, motors, Numerical techniques for transient analysis	09	CO5
	Total Hours	42	

Essential Readings

1. A. Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York.
2. E. Kuffel, W.S.Zangeal & J. Kuffel, “High Voltage Engineering: Fundamentals”, Newnes.

Supplementary Readings

1. L. V. Sluis, “Transients in power systems”, John Wiley & Sons Ltd.
2. R.D. Begamudre, “Extra High Voltage AC Transmission Engineering”, NewAge International.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE315	**Power Plant Engineering**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the fundamentals and subsystems of various power plants.**	Course Outcomes	EE315.1	**Able to acquire knowledge about power plant cycles and identification of its application.**	Knowledge Identification Application
	To teach the principles and optimization of different power cycles		EE315.2	**Able to acquire knowledge about components and optimization of diesel, gas, and combined cycle plants and identification of its application.**	Knowledge Identification Application
	To develop ability and skill in nuclear power plant operations and safety measures		EE315.3	**Able to compute and analyze power plant flow lines and their related issues**	Compute, Design
	To analyze renewable power sources and evaluate their economic and environmental impacts.		EE315.4	**Able to design renewable energy systems and their principles.**	Design
			EE315.5	**Able to analyze economic and environmental aspects of power generation technologies.**	Analyze

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE315.1	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**1**	**1**			**1**	**3**	**2**	**1**
EE315.2	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**2**	**1**			**1**	**3**	**2**	**1**
EE315.3	**3**	**2**	**2**	**3**	**1**		**1**	**1**	**1**			**3**	**3**	**1**	**1**
EE315.4	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**2**	**1**			**1**	**3**	**3**	**2**
EE315.5	**3**	**2**	**2**	**1**	**1**		**3**					**1**	**3**	**1**	**1**
EE315	**3**	**2.6**	**2.6**	**2.6**	**2.2**	**1**	**2.4**	**1.5**	**1**			**1.4**	**3**	**1.8**	**1.2**

SYLLABUS

No.	Content	Hours	COs
I	**Power Plants – Coal:** Rankine cycle – improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment, Binary Cycles and Cogeneration systems.	**08**	**CO1**
II	**Power Plants – Diesel, Gas and Combined Cycle:** Otto, Diesel, Dual & Brayton Cycle – Analysis & Optimisation, Components of Diesel and Gas Turbine power plants, Combined Cycle Plants, Integrated Gasifier based Combined Cycle systems.	**08**	**CO2**
III	**Power Plants – Nuclear:** Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors, Safety measures for Nuclear Power plants.	**08**	**CO3**
IV	**Power Plants – Renewable Sources :** Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines, Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.	**09**	**CO4**
V	**Economic and Environmental Issues:** Power tariff types, Load distribution parameters, Load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants, Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.	**09**	**CO5**
	Total Hours	**42**	

Essential Readings

1. P. K. Nag, "Power Plant Engineering", Tata McGraw – Hill Ltd., Third Edition, 2008.
2. Black and Veatch, "Power Plant Engineering", Springer, 1996.

Supplementary Readings

1. M. M. El-Wakil, "Power Plant Technology", Tata McGraw – Hill Ltd., 2010.
2. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Standard Handbook of Power Plant Engineering", McGraw – Hill, Second Edition, 1998.
3. Godfrey Boyle, "Renewable Energy", Open University and Oxford University Press, 2004

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Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE317	**Digital Signal Processing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To make students familiar with the DSP concepts and aware about the implications of the properties of systems and signals.		EE317.1	**Use** concepts of trigonometry, complex algebra, Fourier series, transform and properties, z-transform to analyze the operations on signals and acquire knowledge about Systems.	Knowledge Understand
	To learn time domain and frequency domain analysis		EE317.2	**Select** proper tools, methods, processes, techniques for time domain and frequency domain evaluation.	Understand Apply
	To learn the different frequency transform techniques and apply on the digital filter design techniques		EE317.3	**Design**, implementation, analysis and comparison of digital filters for processing of discrete time signals	Apply Evaluate Crete
	To learn the implementation techniques of digital filter and analyze its characteristics based on different conditions.		EE317.4	**Integrate** computer-based tools, hardware knowledge components and their operation effects for engineering applications	Apply Evaluate Crete
			EE317.5	**Employ** signal processing strategies at multidisciplinary team activities.	Evaluate, Crete

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE317.1	**1**	**2**	**1**	**2**	**2**				**1**	**1**		**1**	**1**		
EE317.2	**2**	**1**	**1**	**2**	**2**	**1**			**1**	**1**		**1**	**2**	**1**	**1**
EE317.3	**2**	**1**	**1**	**1**			**1**		**1**	**1**		**1**	**2**	**3**	**3**
EE317.4	**1**	**1**	**1**	**1**	**1**	**1**			**1**	**1**		**1**	**2**	**3**	**3**
EE317.5	**1**	**2**	**3**	**2**	**2**	**2**			**1**	**1**		**1**	**2**	**1**	**1**
EE317	**1.4**	**1.4**	**1.4**	**1.6**	**1.75**	**1.33**	**1**		**1**	**1**		**1**	**1.8**	**2**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Unit 1: Review of Discrete-Time Signals and Systems** Discrete - Time Signals, Signal Classification, Discrete - Time System And Analysis Of Discrete - Time Linear Time Invariant Systems, Correlation Of Discrete - Time Signals.	**6**	**CO1**
II	**Unit 2: Fast Fourier Transform** Introduction, Direct Evolution Of DFT, The Fast Fourier Transform, Decimation-In-Time Algorithm, Summary Of Steps Of Radix-2 DIT-FFT Algorithm, Decimation-In-Frequency Algorithm, Summary Of Steps Of Radix-2 DIF-FFT Algorithm.	**6**	**CO2**
III	**Unit 3: Finite Impulse Response Filters** Causality And Its Implications, Linear Phase FIR Filters, Frequency Response Of Linear Phase FIR Filters, Location Of The Zeros Of Linear Phase FIR Filters, The Fourier Series Method Of Designing FIR Filters, Design Of FIR Filter Using Windows, Digital Differentiator, Hilbert Transformers, Frequency Sampling Method Of Designing FIR Filters, Optimum Equi-ripple Approximation Of FIR Filters.	**6**	**CO3**
IV	**Unit 4: Infinite Impulse Response Filters** Introduction, Frequency Selective Filter, Design Of Digital Filter From Analog Filter, Analog Low Pass Filter Design, Analog Low Pass Butterworth Filter, Analog Low Pass Chebyshev Filter, Comparison Between Butterworth Filter And Chebyshev Filter, Frequency Transformation In Analog Domain, Design Of High Pass, Bandpass And Bandstop Filters, Design Of IIR Filters From Analog Filters, Approximation Of Derivatives, Design Of IIR Filter Using Impulse Invariance Technique, Design of IIR Filter Using Bilinear Transformation, Frequency Transformation In Digital Domain	**7**	**CO3**
V	**Unit 5: Finite Word Length Effects in Digital Filters** Floating Point Numbers, Block Floating Point Numbers, Quantization Noise, Input Quantization Error, Product Quantization Error, Coefficient Quantization Error, and Quantization In Floating Point Realization Of IIR Digital Filters, Finite Word Length Effect In FIR Digital Filters	**5**	**CO4**
VI	**Unit 6: Realization of Digital Filter** Realization of FIR Filters, Transversal Structure, Linear Phase Realization, Lattice Structure Of An FIR Filter, Polyphase Realization of FIR Filter, Realization of Digital Filter, Direct Form-I Realization, Direct Form-11 Realization, Signal Flow Graph, Transposition Theorem And Transposed Structure, Cascade Form, 6 Parallel Form Structure, Lattice Structure Of IIR System, Comb Filter, All Pass Filter, Minimum Phase, Maximum Phase And Non-minimum Phase Systems.	**7**	**CO4**
VII	**Unit 7: Multirate Signal Processing** Introduction, Down Sampling, Spectrum of The Down Sampled Signal, Up Sampling Spectrum Of The Up-Sampled Signal, Anti-Imaging Filter, Cascading Sample Rate Converters, Efficient Transversal Structure For Decimator, Efficient Transversal Structure For Interpolator, Polyphase Structure Of Decimator, Polyphase Decimation Using The Z- Transform, Polyphase Structure Of Interpolator	**5**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach," Tata McGraw-Hill.
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education.
3. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing," PHI.

4. Tarun Kumar Rawat, “Digital Signal Processing,” Oxford University Press, 2015.

Supplementary Readings

1. Padmanabhan K., “A Practical Approach to Digital Signal Processing,” New Age International

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE319	**Principles of Digital Communications**	**------**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		CO's	Statement	Bloom's Taxonomy
	To introduce digital communications and geometric representation of signals			EE319.1	**Able to acquire knowledge about digital communications, geometric representation of signals and its application**	Knowledge Application
	To teach random variables & random processes			EE319.2	**Able to acquire knowledge about random variables, random processes and their application**	Knowledge Application
	To introduce concept about different waveform coding & modulation			EE319.3	**Able to compute the waveform coding and modulation**	Compute
	To develop ability and skill about various binary modulation schemes and hypothesis testing			EE319.4	**Able to utilize different modulation schemes and hypothesis**	Utilize
	To discuss performance analysis of different signaling and communication schemes			EE319.5	**Able to apply signaling and communication schemes**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE319.1	**3**	**3**	**2**	**1**					**2**				**3**	**2**	**3**
EE319.2	**3**	**3**	**2**	**1**					**2**				**2**	**2**	**2**
EE319.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**		**1**			**2**	**2**	**3**	**2**
EE319.4	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE319.5	**2**	**2**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE319	**2.4**	**2.6**	**2.6**	**1.2**	**2**	**2**	**2.67**		**1.8**			**1.33**	**2.6**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Digital communications: Interfaces and channels for digital communications, Geometric representation of signals: Geometric representation of signals, Gram-Schmidt orthogonalization, Geometric interpretation of signals	**06**	**CO1**
II	**Review on Random Variables & Processes** Random variables: Introduction to random variables, joint probability density function, characteristic functions, derived distributions, Random process: Introduction to random processes, Gaussian process, Linear functional of random process, Stationary and wide sense stationary random process, Power spectral density, White Gaussian noise	**09**	**CO2**
III	**Waveform Coding & Modulation** Waveform coding: Pulse code modulation, Differential pulse code modulation, and delta modulation, Modulation - I: Complex baseband representation, degrees of freedoms, linear modulation, spectral description of linearly modulated signals, Modulation – II: Nyquist criterion, raised cosine family of pulses, Inter symbol interference	**09**	**CO3**
IV	**Binary Modulation & Hypothesis Testing** Modulation - III: Coherent binary modulation formats, e.g. ASK, FSK and PSK, Coherent QAM, M-ary modulation techniques, Orthogonal and biorthogonal modulation. Hypothesis testing: Optimum decision region in AWGN, Maximum Aposteriori Probability (MAP) and Maximum Likelihood Receiver, Theorem of irrelevance	**09**	**CO4**
V	**Performance Analysis** Binary and M-ary signaling schemes: Performance analysis of binary signaling schemes, performance analysis of M-ary signaling schemes, bit-level demodulation. Non-coherent communication: Composite hypothesis testing, optimal demodulation for non-coherent communication. Non-coherent communication: Performance of binary and M-ary non-coherent communication	**09**	**CO5**
Total Hours		**42**	

Essential Readings

1. Robert G. Gallager, “Principles of Digital Communication,” Cambridge University Press, 2008.
2. Upamanyu Madhow, “Fundamentals of Digital Communication,” Cambridge University Press, 2008.
3. John G. Proakis and Masoud Salehi, “Fundamentals of Communication Systems,” Pearson Education India, 2007.

Supplementary Readings

1. John M. Wozencraft and Irwin M. Jacobs, “Principles of Communication Engineering,” Wiley, 1965.
2. Simon Haykin, “Communications Systems,” John Wiley, 2008.
3. Amos Lapidoth, “A foundation in Digital Communication,” Cambridge University Press, 2017.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE321	**Sensors & Actuators**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the applications of sensors and actuators		EE321.1	Understanding terminology and functionally of various types of sensors	Knowledge Understand
	To learn the circuit design for sensors and actuators		EE321.2	Understanding terminology and functionally of various types of actuators	Knowledge Understand
			EE321.3	Describe the design the essential signal conditioning circuit for sensors and actuators	Evaluate Analyze Understand
			EE321.4	Understanding the design and fabrication of Sensors and Actuators	Understand Apply Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE321.1	**3**	**3**		**1**		**1**			**1**			**1**	**3**		**3**
EE321.2	**3**	**3**		**1**		**1**			**1**			**1**	**2**		**2**
EE321.3	**2**	**3**	**3**	**1**	**2**	**1**						**1**	**2**	**3**	**2**
EE321.4	**2**	**3**	**3**	**1**	**2**	**1**						**1**	**2**	**3**	**2**
EE321	**2.5**	**3**	**3**	**1**	**2**	**1**			**1**			**1**	**2.25**	**3**	**2.25**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1: Sensors** Introduction, sensors performance terminology; distance, movement, proximity, strain, stress, Force, Fluid/ Flow/ Level/Pressure, Light, temperature sensors; Basics of Energy Transformation: Transducers, Sensors and Actuators,	**11**	**CO1**
II	**Module 2: Actuators** Explain working principles of Actuators, Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications	**11**	**CO2**
III	**Module 3: Signal Conditioning** Signal conditioning process, analog signal conditioning- passive circuits, active circuits (Op-amp), digital signal conditioning (sampling and quantization), ADC DCA, frequency-based converters data acquisition Systems.	**10**	**CO3**
IV	**Module 4: Design and fabrication of Sensors and Actuators** Understanding of thin film physics, thin film deposition techniques, Basics understanding of Photolithography, Design and fabrication process of Microsensors	**10**	**CO4**
Total Hours		**42**	

Essential Readings

1. W. Bolton, "Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering" Pearson publication, 5th Edition 2012
2. Sensors and Signal Conditioning Wiley-Blackwell, 2008 Jacob Fraden, Handbook of modern sensors, Springer, Stefan Johann Rupitsch.
3. Piezoelectric Sensors and Actuators: Fundamentals and Applications, Springer, 2018

Supplementary Readings

1. Lecture notes on some topics will be provided by the instructor Pallás-Areny Ramón, and John G. Webster.
2. VLSI Technology, 2 Edition, McGraw Hill,
3. NPTL link: https://archive.nptel.ac.in/courses/108/108/108108147/

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE323	**Aircraft Control Systems**	------	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To introduce closed loop aircraft control systems and mathematical modeling**	EE323.1	**Able to acquire knowledge about closed loop aircraft control systems modeling and its application**	Knowledge Application
	To teach linear control techniques and their performances	EE323.2	**Able to acquire knowledge about linear control techniques and identification of their performances**	Knowledge Identification
	To develop ability and skill to analyze stability of aircraft control systems	EE323.3	**Able to compute the stability of aircraft control systems**	Compute
	To develop skill to design various linear techniques of aircraft autopilot	EE323.4	**Able to design of linear techniques of aircraft autopilot**	Design
	To introduce different approximations for the aircraft autopilot design	EE323.5	**Able to design and apply approximations for the aircraft autopilot design**	Design Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE323.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE323.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE323.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
EE323.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE323.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE323	**2.0**	**2.4**	**2.6**	**2.25**	**2.0**	**1.8**	**1.6**	**1.0**	**2.0**			**2.0**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Why control system in Aircraft? Automatic control to Aerospace Systems. Linear Time Invariant System. Equilibrium Points, Static and Dynamic Stability. Stability Analysis with Respect to Equilibrium points, Example on Nonlinear System, Linearization method, State-space model, Laplace transform and Transfer Function, Examples.	**08**	**CO1**
II	Linearization to Aircraft's Rotational Motion. Linear state model of aircraft attitude motion. Transfer function of aircraft attitude motion with respect to reference attitude, disturbance, and noise. Effect of controller in closed-loop transfer function. Typical control laws-Proportional, Proportional-Derivative, and Proportional-Integral- Derivative. Transient and steady state Response of Standard 2nd order System, Effect of Damping Ratio on system's closed-loop poles. Steady State Specifications, Effect of Disturbance on steady state performance, Examples.	**10**	**CO1 CO2**
III	Stability Analysis for Autopilot Design: Routh Stability Criteria, Marginal Stability, Root Locus. Rules to find the stability margins for autopilot design using Root Locus, Examples, Effect of Addition of Poles and Zeros to the autopilot system, Compensators.	**07**	**CO3**
IV	Gain Tuning method, PID control for the design of autopilot using Root Locus, Examples, Review on Aircraft Equation of motion, Aircraft Reference Model, Small perturbation to Aircraft Equation. Linearized State-Space Model of Longitudinal and Lateral / Directional Equations of Motion for the Aircraft Autopilot Design. Longitudinal motion approximation. Short period approximation.	**10**	**CO4**
V	Spiral mode, Roll mode and Dutch Roll approximations. Examples for longitudinal and lateral approximations for the Aircraft Autopilot Design. Lateral flying qualities. Aircraft Transfer Function in terms of Phugoid and Short Period Dynamics for Autopilot Design.	**07**	**CO5**
	Total Hours	**42**	

Essential Readings

1. G. F. Franklin, J. D. Powell and A. E. Naeini, "Feedback Control of Dynamical Systems", Prentice Hall, 6th Edition, 2009.
2. R. Nelson, "Flight Stability and Automatic Control", McGraw Hill Education, 2nd Edition, 2007.
3. A. H. Ruiter, C. Damaren, and J. R. Forbes, "Spacecraft Dynamics and Control: An Introduction", Wiley, 1st Edition, 2013.

Supplementary Readings

1. A. Tewari, "Modern Control Design with MATLAB and Simulink", John Wiley & Sons, Chichester, 2002.
2. A. Tewari, "Automatic Control of Atmospheric and Space Flight Vehicles", Birkkhauser, 1st Edition, 2011.
3. K. R. Yeedavalli, "Flight Dynamics and Control of Aero and Space Vehicles", Willey, 1st Edition, 2020.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE371	**Fundamentals of Electric Vehicles**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
Introduce different components of EV and its power train		EE371.1	Understand the basic of EV dynamics	Knowledge Application
Give knowledge about different motor used in EV and their operation.		EE371.2	Differentiate different components of EV power train	Comprehension Synthesis
Give an insight of energy storage and charging technology		EE371.3	Control different EV motors according to the road condition.	Application Analysis
		EE371.4	Operate different component used in motor control.	Comprehension Evaluation
		EE371.5	Analyze the different charging technology of the EV.	Comprehension Synthesis
		EE371.6	Understand different technology used in EV battery.	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE371.1	**3**		**1**	**1**		**1**	**1**		**2**			**3**			
EE371.2	**3**	**1**	**1**	**1**		**1**	**1**		**2**			**3**	**1**	**1**	
EE371.3	**3**	**2**	**2**	**2**	**3**	**2**	**1**		**2**			**3**	**3**	**2**	**2**
EE371.4	**3**	**2**	**2**	**2**	**2**	**2**	**1**		**1**			**3**	**2**	**2**	**2**
EE371.5	**3**	**1**	**2**	**2**	**3**	**1**	**1**		**1**			**3**	**3**	**1**	**2**
EE371.6	**3**	**2**	**2**	**2**	**2**	**1**	**1**		**2**			**3**	**2**	**1**	**2**
EE371	**3.00**	**1.60**	**1.67**	**1.67**	**2.50**	**1.33**	**1.00**		**1.67**			**3.00**	**2.20**	**1.40**	**2.00**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** History and benefits of electric vehicles; fundamentals of EVs; tractive effort; vehicular dynamics; drive cycle and vehicle control unit.	**04**	**CO1**
II	**Components of Power Train** Components of conventional vehicle and propulsion load; power train of HEV and EV; efficiency considerations for conventional vehicle, HEV and EV; multi-motor in-wheel EVs; impact and benefits of EV on utility grid	**06**	**CO2**
III	**EV Motors Drive Topologies** Brushed and Brushless DC motor characteristics, Induction motor characteristics, Overview of PMSM and Switched reluctance motor, Field oriented control, Direct torque control, Position sensorless control, Torque ripple minimization control, flux weakening control different types of motor.	**10**	**CO3**
IV	**Elements of drives** Encoders, Resolvers, R/D Converters, Hall current sensors and current sampling, Voltage Model Estimator, Current Model Estimator, Closed-loop MRAS observer, Sliding Mode Observer. Modulation schemes: Sinusoidal PWM, Injection of third order harmonics, Space Vector Modulation, Dead time & compensation, comparison of modulation techniques.	**10**	**CO4**
V	**Charging Technology** EV charger classification, Different topologies of AC chargers, Front End Boost converter, Isolated DC – DC converter, modelling and control of bi-directional DC-DC converters, Wireless charging technologies.	**06**	**CO5**
VI	**Overview of Battery Technologies** Types of Battery, Introduction to Electrochemical Battery, Electrochemical Reactions, Battery Parameters: Battery Capacity, Discharge Rate, Charging Rate, SOC, SOD, SOH, DOD, Thermodynamic Voltage, Specific Energy, Specific Power, Energy Efficiency, Battery Technologies (used in Tesla Car), Lead-Acid Battery, Nickel Based Battery, Lithium Battery (Li-ion Li-Polymer), Role in Electric Drive Train, Comparisons, Introduction to Graphene Battery, Proposed Batteries	**06**	**CO6**
Total Hours		**42**	

Essential Readings

1. Ali Emadi, "Advanced Electric Drive Vehicles" CRC Press, 1st Edition, 2014.
2. Werner Leonhard, "Control of Electrical Drives", 3rd Edition, 2001.

Supplementary Readings

1. R Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press, 2010.
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Prentice Hall PTR, 2001.
3. Berker B., James W. J. & A. Emadi, "Switched Reluctance Motor Drives", CRC Press, 2019
4. Chen Liao, "Batteries: Materials Principles and Characterization Methods" institute of physics publishing, 2021.

2. Bimal K. Bose, “Modern Power Electronics and AC Drives”, Prentice Hall PTR, 2001.
3. Berker B., James W. J. & A. Emadi, “Switched Reluctance Motor Drives”, CRC Press, 2019
4. Chen Liao, “Batteries: Materials Principles and Characterization Methods” institute of physics publishing, 2021.

	National Institute of Technology Meghalaya An Institute of National Importance	MAPPING & EVALUATION SCHEME

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C			END	Total
EE375	**Summer Internship 1**	**0**	**0**	**0**	**1**			**100**	**100**

		After the completion of the course, the student should be able to:		
Course Objectives	**To familiarize about organization structure of the industry**	**Course Outcomes**	**EE375.1**	**Understand the organization structure of the industry and focus on skill enhancement**
	To develop skill on training task		**EE375.2**	**Prepare a well-organized training tasks**
	To prepare and present the training report and present via power point presentation		**EE375.3**	**Deliver a constructive presentation**
			EE375.4	**Prepare effective training report**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	**EE375.1**	3		3		2	2			3	3	3	3	2	3	
2	**EE375.2**										3	3	3		2	3
3	**EE375.3**	3	2							3	2		3	2	2	2
4	**EE375.4**	3	2								3	2	2	3	3	2
Avg. COs		**3.00**	**2.00**	**3.00**		**2.00**	**2.00**			**3.00**	**2.75**	**2.67**	**2.75**	**2.33**	**2.50**	**2.33**

Mapping of COs with Knowledge Level (KL)

CO1	K3 : Applying
CO2	K3 : Applying; K4 : Analysing
CO3	K3 : Applying
CO4	K3 : Applying
CO5	

Training Evaluation Scheme (END)

Items	**Internship Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	CO1	CO2, CO3	CO3, CO4	CO3	CO2, CO3, CO4	CO5	CO2, CO3, CO5	CO3, CO4	CO5		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100

	National Institute of Technology Meghalaya An Institute of National Importance		MAPPING & EVALUATION SCHEME
Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C		MID	END	Total
EE331	**Seminar and Technical Report Writing**	**0**	**0**	**2**	**1**		**30/100**	**70/100**	**100**

			COs	**Statement**
		After the completion of the course, the student should be able to:		
Course Objectives	**To introduce the search skill for recent technical topics from interested domains in engineering and technology**	**Course Outcomes**	**EE331.1**	**Identify recent technical topics from interested domains.**
	To teach the use modern software tools model, fundamental knowledge, and skills for seminar and technical report writing		**EE331.2**	**Analyze the applicability of modern software tools and technology.**
	To develop skills to prepare and present the technical report and present via power point presentation		**EE331.3**	**Demonstrate the presentation and communication skills.**
			EE331.4	**Demonstrate the technical report preparation skills.**

COs	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE331.1	1	3	3		3		3	2	3	3	3	3	3	3	2
EE331.2	3	3	3		2		3	3	2	3	3	2	2	3	3
EE331.3	2	1	1	3	1	2	1				2	3	2	3	3
EE331.4	3			3	2	3	2			2	1	2	1	2	1
Avg. EE331	2.25	2.33	2.33	3	2	2.5	2.25	2.5	2.5	2.67	2.25	2.5	2	2.75	2.25

Mapping of COs with Knowledge Level (KL)	
EE331.1	K3 : Applying
EE331.2	K4 : Analysing
EE331.3	K3 : Applying
EE331.4	K3 : Applying

Evaluation Scheme (MID/END)

Items	**Project Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	EE331.1	EE331.2 EE331.3	EE331.3 EE331.4	EE331.3	EE331.2 EE331.3	EE331.4	EE331.2 EE331.3	EE331.3 EE331.4	EE331.4		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100

	National Institute of Technology Meghalaya An Institute of National Importance		MAPPING & EVALUATION SCHEME
Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C		MID	END	Total
EE381	**Minor Project-1**	**0**	**0**	**4**	**2**		**30/100**	**70/100**	**100**

			COs	**Statement**
		After the completion of the course, the student should be able to:		
Course Objectives	**To introduce the basic concepts for preparing proposal on engineering and technology**	**Course Outcomes**	EE381.1	**Use critical and creative thinking to prepare proposal on engineering and technology**
	To teach the use modern engineering tools model, fundamental knowledge, and skills to develop methodology or prototype		EE381.2	**Design the system components and use the appropriate modern engineering tools**
	To develop skills to prepare and present the technical report and present via power point presentation		EE381.3	**Apply fundamental knowledge and skills to develop methodology or prototype as a team**
			EE381.4	**Incorporate the suggestions made to improve the project quality for societal and environmental contexts**
			EE381.5	**Demonstrate the project and prepare technical report as a team**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE381.1	1	3	3		3		3	2	3	3	3	3	3	3	2
EE381.2	3	3	3		2		3	3	2	3	3	2	2	3	3
EE381.3	2	1	1	3	1	2	1				2	3	2	3	3
EE381.4	3			3	2	3	2			2	1	2	1	2	1
EE381.5	1	1	1		1	2	3	3	2	3	2	2	2	2	1
Avg. **EE381**	**2.00**	**2.00**	**2.00**	**3.00**	**1.80**	**2.33**	**2.40**	**2.67**	**2.33**	**2.75**	**2.20**	**2.40**	**2.00**	**2.60**	**2.00**

Mapping of COs with Knowledge Level (KL)

EE381.1	K3 : Applying
EE381.2	K3 : Applying; K4 : Analysing
EE381.3	K4 : Analysing; K5 : Evaluating
EE381.4	K6 : Creating
EE381.5	K3 : Applying

Project Evaluation Scheme (MID/END)

Items	**Project Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	EE381.1	EE381.2 EE381.3	EE381.3 EE381.4	EE381.3	EE381.2 EE381.3 EE381.4	EE381.5	EE381.2 EE381.3 EE381.5	EE381.3 EE381.4	EE381.5		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
EE351	**Power System II Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the economics of power system operation and perform load flow analysis.		EE351.1	**Able to acquire knowledge about the operation of large power systems and understand the stability issues.**	Knowledge Understand
	To develop an ability and skill to analyse power system faults and stability.		EE351.2	**Able to analyse load flow of power system and compute faults in the transmission network.**	Analyse Compute
	To understand the requirements and methods of real and reactive power control in power system.		EE351.3	**Able to compute fault current and analyse its sequence components in the transmission network.**	Compute, Analyze
	To realize optimal scheduling of hydro-thermal generation.		EE351.4	**Able to understand the frequency and voltage control mechanism of power systems and perform economic load dispatch.**	Understand
			EE351.5	**Able to understand and design the unit commitment problem considering various constraints and perform hydro-thermal generation scheduling.**	Understand, Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE351.1	**3**	**3**	**2**	**2**	**2**		**1**					**1**	**3**		
EE351.2	**3**	**3**	**3**	**3**	**3**		**1**	**1**				**1**	**3**		**3**
EE351.3	**3**	**3**	**3**	**3**	**3**			**1**				**1**	**3**		**3**
EE351.4	**3**	**3**	**3**	**3**	**3**		**2**	**1**				**1**	**3**		**3**
EE351.5	**3**	**3**	**3**	**3**	**3**		**2**	**1**				**1**	**2**		**3**
EE351	**3**	**3**	**2.8**	**2.8**	**2.8**		**1.5**	**1**				**1**	**2.8**		**3**

SYLLABUS

No.	Content	Hours	COs
1	Introduction to MATLAB, Siemens PSSE and SINCAL software's	**02**	**CO1 CO2 CO3 CO4 CO5**
2	Construction of bus admittance and impedance matrices for a given power system	**02**	
3	Power flow analysis using Gauss-Seidal technique given the power system	**02**	
4	Power flow analysis using the Newton-Raphson technique of a given power system	**02**	
5	Single-phase, double-phase and three-phase fault analysis in the given power system	**02**	
6	Computation of sequence components under fault in the given power system	**02**	
7	Computation of alternator rotor angle oscillations in a given power system	**02**	
8	To solve economic load dispatch considering losses in Matlab	**02**	
9	To perform the analysis and control on multi-area system in Matlab Simulink.	**02**	
10	To solve unit commitment problem using dynamic programming method.	**02**	
11	To perform hydro-thermal scheduling program using gradient method in Matlab.	**02**	
12	Make–up laboratory class	**02**	
	Total Hours	**24**	

Essential Readings

1. W. D. Stevenson, "Element of Power System Analysis", Tata McGraw Hill, 4th edition, 1982
2. J. Nagrath and D.P. Kothari, "Power System Engineering", Tata McGraw Hill, 2nd edition, 2007
3. O.I. Elgerd, "Electrical Energy System Theory: An introduction", 2nd Edition, 1983, TMH.

Supplementary Readings

1. P. Kundur, "Power System Stability and Control", Tata McGraw Hill, 1st edition, 2006
2. G. W. Stagg and A. H. EI-Abaid, "Computer Methods in Power System Analysis", McGraw Hill, 1st edition, 1971

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE353	**Power Electronics Lab**	**NIL**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- To understand the operation of different power electronic switches and their applications
- To know about on load operation of converters
- To understand control strategies of converter operation
- To perform steady state analysis of different converters

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE353.1	Understand the operation of different power electronics switches and their usage for different applications.	Knowledge Application
EE353.2	Design power electronics converters to convert the ac supply into dc.	Comprehension Synthesis
EE353.3	Design power electronics converters to convert fixed dc supply into variable dc.	Application Analysis
EE353.4	Design power electronics converters to convert dc supply into ac.	Comprehension Evaluation
EE353.5	Design power electronics converters to convert fixed ac supply into variable ac supply.	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE353.1	**3**	**1**	**2**	**1**		**1**						**2**			
EE353.2	**3**	**3**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE353.3	**3**	**3**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE353.4	**3**	**3**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE353.5	**3**	**2**	**3**	**1**	**2**	**1**	**1**					**3**	**3**	**2**	**1**
EE353	**3.00**	**2.40**	**2.80**	**1.00**	**2.00**	**1.00**	**1.00**					**2.80**	**3.00**	**2.00**	**1.00**

SYLLABUS

No.	Content	Hours	COs
1	**To study and plot the VI characteristic of SCR**	**02**	**CO1**
2	**To study and plot the VI characteristic of UJT and calculate Inter base resistance and Intrinsic stand- off ratio.**	**02**	**CO1**
3	**To study and plot the VI characteristic of MOSFET.**	**02**	**CO1**
4	**To study and plot the VI characteristic of IGBT.**	**02**	**CO1**
5	**To study Different SCR Triggering Circuits.**	**02**	**CO1**
6	**To study a synchronized UJT triggering circuit to trigger an SCR Half Wave rectifier and to find load voltage for various firing angles.**	**02**	**CO2**
7	**To study a 1 phase Controlled full Bridge converter with R-Load and RL-Load.**	**02**	**CO2**
8	**To study type A chopper circuit.**	**02**	**CO3**
9	**To study a 1 phase full bridge inverter with R & RL load.**	**02**	**CO4**
10	**To study SCR Based Single phase AC voltage Controller Circuit**	**02**	**CO5**
	Total Hours	**20**	

Essential Readings

1. M. H Rashid, "Power Electronics Circuits, Devices, and Applications", Prentice-Hall of India Pvt. Ltd, 3rd Edition, 2014
2. L. Umanand, "Power Electronics Essential and Applications", Willey, 1st Edition, 2009.

Supplementary Readings

3. P. S. Bimbhra, "Power Electronics", Khanna Publishers, 5th edition, 1990.
4. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill Publishing Co. Ltd, 2nd Edition, 2006
5. M. Ned and T. M. Undeland, "Power Electronics Converters Applications and Design", John Willey Inc, 3rd Edition, 2002.
6. J. P. Agrawal, "Power Electronic Systems: Theory and Design", Addison Wesley Longman Pte. Ltd, 1st Edition, 2001.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE355	**Linear Control Systems Lab**	-------	**0**	**1**	**2**	**2**	**70**	**30**	**100**

Course Objectives	
	To introduce the basic concepts, elements and terminologies of control systems toolbox in MATLAB
	To model different physical systems (plants) in Laplace and state-space frameworks in MATLAB
	To discuss the performance and stability of LTI systems in time and frequency domains using MATLAB
	To develop ability and skill to design compensators/ controllers using graphical techniques in MATLAB

Course Outcomes	CO's	Statement	Bloom's Taxonomy
	EE355.1	**Able to acquire knowledge about the control systems commands and identification of their application**	Knowledge Identification Application
	EE355.2	**Able to perform the mathematical modeling of dynamic systems in transfer function and state-space forms.**	Perform
	EE355.3	**Able to analyse and define the LTI system performance and stability in both time-domain and frequency domain.**	Analyze Define
	EE355.4	**Able to compute the Root locus and design the appropriate compensator using Root locus technique.**	Compute Design
	EE355.5	**Able to compute Bode, Nyquist plots and design the appropriate compensator using Bode plot technique.**	Compute Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE355.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE355.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE355.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
EE355.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE355.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE355	**2.00**	**2.40**	**2.60**	**2.25**	**2.00**	**1.80**	**1.60**		**2.00**			**2.00**	**2.60**	**2.75**	**2.60**

SYLLABUS

No.	Content	Hours	COs
1	**Introductory Laboratory Class**	**02**	
2	**Introduction to Control Engineering MATLAB Commands**	**02**	
3	**Block Diagram Reduction and Pole-Zero plot**	**02**	
4	**Dynamic response of a plant model with different inputs**	**02**	
5	**Determination of Step & Impulse Response for First and Second Order Unity Feedback System**	**02**	**CO1**
6	**Determination of Damping Effect on the Standard Second Order System**	**02**	**CO2**
7	**Study the Transient Performance Specifications of Standard Second Order System**	**02**	**CO3** **CO4**
8	**Determination of Impulse and Step Response for a Type '0' Type '1' and Type '2' Systems**	**02**	**CO5**
9	**Determination of Root Locus plot using MATLAB control system toolbox**	**02**	
10	**Determination of Bode plot using MATLAB control system toolbox**	**02**	
11	**Design the appropriate compensator using Root locus and Bode plot technique**	**02**	
12	**Make – up Laboratory Class**	**02**	
	Total Hours	**24**	

Essential Readings

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 5th Edition, 2010.
2. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International, 6th Edition, 2018.

Supplementary Readings

1. N. S. Nise, "Control System Engineering", Wiley India, 7th Edition, 2015.
2. R. C. Dorf, R. H. Bishop, "Modern Control Systems", Pearson, 13th Edition, 2017.

3rd Year: Semester-6

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE302	**Industrial Drives and Control**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	This course describes the operation, application and control of variable speed drives.	Course Outcomes	EE302.1	Able to remember various applications in industrial and domestic areas where use of electric drives are essential.	Knowledge Application
	This course familiarizes the operation principles and design of drives for different transient conditions.		EE302.2	Able to understand types of drive systems based on nature of loads, control objectives, performance and stability.	Comprehension Synthesis
	This course introduces strong foundation to assess performance of different industrial drives.		EE302.3	Able to understand the need of DC drives and their operations with power electronics converter for automations in industries.	Application Analysis
	This course illustrates practical viabilities of different electrical drives towards energy efficiency.		EE302.4	Able to understand the need of AC drives and their operations with power electronics converter for automations in industries.	Comprehension Evaluation
			EE302.5	Able to understand the critical areas in application levels, and derive typical solutions using special drives	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE302.1	**3**	**1**	**2**	**1**		**2**	**1**					**2**			
EE302.2	**3**	**2**	**2**	**1**	**1**	**2**	**1**					**3**			**1**
EE302.3	**3**	**3**	**3**	**2**	**3**	**1**	**1**					**3**	**3**	**2**	**2**
EE302.4	**3**	**3**	**3**	**2**	**3**	**1**	**1**					**3**	**3**	**2**	**2**
EE302.5	**3**	**2**	**3**	**2**	**3**	**1**	**1**					**3**	**3**	**2**	**2**
EE302	**3.00**	**2.20**	**2.60**	**1.60**	**2.50**	**1.40**	**1.00**					**2.80**	**3.00**	**2.00**	**1.75**

SYLLABUS

No.	Content	Hours	COs
I	**Fundamentals of Electric Drives** Electrical drives and introduction: Electric drives, advantages of electrical drives, parts of electrical drives, choice of electrical drives, status of ac and dc drives, Speed Sensing and current Sensing	**06**	**CO1**
II	**Dynamics of Electrical Drives** Fundamental torque equation, speed-torque convention and multi quadrant operation, , dynamics of motor load combination, Types of load, load with translational motion, load with rotational motion, load torque that vary with time nature and classification of load torque, measurement of moment of inertia, calculation of acceleration time in transient operation, acceleration time for specific nature of motor and load torque, load equalization, stability of electrical drives. Selection of Motor Power Rating	**10**	**CO2**
III	**Power Electronics control of DC drives** Review of DC Motors and its performance, starting, braking, controlled rectifier fed DC drives with continuous and discontinuous mode of operation, Supply Harmonics, Power Factor and ripple in motor current, Chopper Controlled DC Drives, Sources current harmonics in chopper, Converter Ratings and closed loop control	**10**	**CO3**
IV	**Power Electronics control of AC drives** Review of Three phase Induction Motor and its performance, starting, braking, Static Voltage control, Variable Frequency Control (VSI, CSI, Cyclo-converter based), static rotor resistance control and slip power recovery control schemes. Review of Three phase Synchronous Motor and its performance, Self-controlled schemes, Variable frequency control of multiple synchronous motor Drives,	**10**	**CO4**
V	**Special Drives** Fundamentals of operations for Permanent magnet AC motor drives, Brushless DC Motor Drives.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Dubey G.K, "Fundamentals of Electrical Drives", Narosa Publishing House,2017
2. Pillai S.K., "A First Course on Electrical Drives", New Age International,2018

Supplementary Readings

3. De N.K., Sen P.K. "Electric Drives", Prentice Hall of India ,2018
4. Krishnan. R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall of India ,2016
5. Ned Mohan et al, "Power Electronics: Converters, Applications, and Design", John Wiley & Sons. Inc. ,2019
6. Werner Leonhard, "Control of electrical drives", Springer,2015

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE304	**Switchgear and Protection**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- **To introduce electrical switchgear and protective relays**
- **To teach the computation of fault current in the electrical system**
- **To develop an ability and skill to design various relay settings**
- **To develop an ability and skill to design various electrical protection Schemes.**

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	EE304.1	**Able to acquire knowledge about switchgears and identification of its application**	Knowledge Identification Application
	EE304.2	**Able to acquire knowledge about protective relays and identification of application**	Knowledge Identification Application
	EE304.3	**Able to compute the fault current and design of switchgears**	Compute, Design
	EE304.4	**Able to design of protective relays**	Design
	EE304.5	**Able to design of protection schemes for electrical equipments**	Design
	EE304.6		

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE304.1	**3**	**3**		**1**					**2**				**3**		**3**
EE304.2	**3**	**3**		**1**					**2**				**2**		**2**
EE304.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE304.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE304.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE304	**2.4**	**2.6**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**2.4**	**3**	**2.4**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Substation equipment, fault clearing process, different types of switchgear	**04**	**CO1**
II	**Circuit Breakers** Properties of arc, Arc interruption theories, Re-striking and Recovery voltage, Resistance switching, Current chopping, capacitive current interruption, auto reclosing, classification, construction, functioning, selection, and applications of circuit breakers, ratings, recent developments in circuit breakers	**10**	**CO1**
III	**L.T. Switchgear** Characteristics & applications of other circuit-breaking devices such as miniature air circuit breakers, moulded case circuit breakers, contactor types, re-wirable & H.R.C. fuses, earth leakage breakers	**07**	**CO1** **CO2**
IV	**Protective Relaying** Basic requirements of protective relaying, classification of relays, non-directional over-current and directional over current relay, differential and distance relays, carrier current protection, negative phase sequence, harmonic restraint relays, reverse power, earth fault relays	**12**	**CO2** **CO3** **CO4**
V	**Protection Schemes** Types of faults and protection schemes for alternators, transformers, bus-bars, transmission lines, feeders, lightning arresters, arcing grounds, neutral earthing	**10**	**CO4** **CO5**
VI	**Intelligent Protection** Introduction to digital and numerical relays, microcontroller/microprocessor-based current, voltage, frequency and distance relays	**05**	**CO2** **CO4**
	Total Hours	**48**	

Essential Readings

1. P. M. Anderson, "Power System Protection", JW and IEEE Press, 1st Edition, 1998.
2. S. S. Rao, "Switchgear Protection and Power Systems", Khanna Publishers, 13th Edition, 1977.

Supplementary Readings

1. C. R. Mason, "Art & Science of Protective Relaying", John Wiley & Sons, 6th Edition, 1967.
2. T. S. M. Rao, "Solid State Protective Relaying", Tata McGraw-Hill, 2nd Edition, 2001.
3. Y. G. Paithankar and S.R. Bhide, "Fundamentals of Power Systems Protection", PHI, 2nd Edition, 2013.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE312	**FACTS Devices**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To understand power flow control issues in the transmission line.
- To understand the application of FACTS in addressing power flow issues.
- To learn about static shunt and series compensation techniques through FACTS devices.
- To learn about combined compensators.

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
EE312.1	Able to understand the basic concept of FACTs, and its application in solving the power flow issues in transmission line.	Understand, Application
EE312.2	Able to understand and apply the principles of series compensation.	Understand, Application
EE312.3	Able to understand and apply the principles of shunt compensation.	Knowledge, Application
EE312.4	Gather knowledge about UPQC and IPFC	Knowledge

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE312.1	**3**	**2**	**2**		**1**							**1**	**2**	**1**	
EE312.2	**3**	**3**	**2**	**1**	**1**							**1**	**3**	**2**	**1**	
EE312.3	**3**	**3**	**2**	**1**	**1**							**1**	**3**	**2**	**1**	
EE312.4	**3**	**3**	**2**	**1**	**1**							**1**	**3**	**2**	**1**	
EE312	**3.00**	**2.75**	**2.00**	**0.75**	**1.00**							**1.00**	**2.75**	**1.75**	**0.75**	

SYLLABUS

No.	Content	Hours	COs
I	FACTS Concepts: Transmission line interconnections, Power flow in an AC system, loading capabilitylimits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers	**10**	**CO1**
II	Static Shunt Compensation: Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable var generation, variable impedance type static var generators, switching converter type var generators, hybrid var generators. SVC and STATCOM: The regulation and slope transfer function and dynamic performance, transient Stability enhancement and power oscillation damping, operating point control, and summary of compensator control.	**11**	**CO1, CO3**
III	Static Series Compensation: Concept of series capacitive Compensation, improvement of transient stability, power oscillation damping, Functional requirements, GTO Thyristor controlled series capacitor (GSC), Thyristor switched series capacitor (TSSC) and Thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.	**11**	**CO1, CO2**
IV	Combined compensators: Unified power flow controller- circuit arrangement, operation and control of UPFC, basic principle of P and Q control, independent active and reactive power flow control. Interlinepower flow controller- basic operating principles and characteristics, control structure	**10**	**CO4**
	Total Hours	**42**	

Essential Readings

1. N. G. Hingorani and L. Guygi, "Understanding FACTS Devices", IEEE Press Publications, 2nd Edition, 2000.
2. R. M. Mathur, R. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", Wiley-IEEE Press, 1st Edition,2000.

Supplementary Readings

1. A. T. John, "Flexible AC Transmission System", Institution of Electrical and Electronic Engineers (IEEE), 1st Edition, 1999.
2. N. G. Hingorani, L. Gyugyl, "Understanding FACTS Concepts and Technology of Flexible AC Transmission System", Standard PublishersDelhi, 1st Edition, 2001.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 314	**Utilization of Electrical Power**	**EE 203**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
❖ To know and familiarise about the applications of electrical power.		EE 314.1	understand various Illumination techniques and design lighting schemes for specific applications	Knowledge & Application
❖ To learn about domestic uses of electric power.		EE 314.2	understand the operation of refrigeration air conditioning, and evaluate the energy efficiency	Knowledge, Identification & Application
❖ To learn about the industrial uses of electrical power		EE 314.3	acquire knowledge about domestic applications of electric power	Knowledge & Application
❖ To learn about the Electric Heating and Electrolytic processes		EE 314.4	acquire knowledge about different methods of heating	Knowledge & Application
❖ To learn about the Traction system		EE 314.5	understand and evaluate the performance of a traction unit.	Identification Application
		EE314.6		

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE 314.1	**3**	**3**	**1**	**1**									**3**		**1**
EE 314.2	**3**	**3**	**1**	**1**									**3**		**1**
EE 314.3	**3**	**3**	**1**	**2**	**1**								**3**	**1**	**1**
EE 314.4	**3**	**3**	**1**	**2**	**1**								**3**	**2**	**1**
EE 314.5	**3**	**3**	**1**	**3**	**1**								**3**	**1**	**2**
EE 314	**3.00**	**3.00**	**1**	**1.80**	**1.00**								**3.00**	**1.30**	**1.40**

SYLLABUS

No.	Content	Hours	COs
I	**Illumination** Terminology, Laws of illumination, Different types of lamps, LED lighting, and Energy efficient lamps. Design of lighting schemes - factory lighting - flood lighting – street lighting.	**06**	**CO1**
II	**Refrigeration** Domestic refrigerator and water coolers. Air-Conditioning - Various types of air conditioning systems and their applications, smart air conditioning units. Energy Efficient motors: Standard motor efficiency, need for more efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.	**08**	**CO1, CO2**
III	**Domestic utilization of electrical energy** House wiring. Induction based appliances, Online and Offline UPS, Batteries. Power quality aspects – nonlinear and domestic loads.	**07**	**CO2, CO4**
IV	**Electric Heating and Electrolytic processes** Types of heating and applications, Electric furnaces - Resistance, inductance and Arc Furnaces, Electric welding and sources of welding– electro-metallurgy and electro-plating.	**09**	**CO4**
V	**Traction system** power supply, traction drives, electric braking, tractive effort calculations and speed-time characteristics. Locomotives and train - recent trend in electric traction.	**06**	**CO4, CO5**
	Total Hours	**36**	

Essential Readings

1. R. K. Rajput, 'Utilisation of Electrical Power', Laxmi Publications, 1st Edition, 2007.
2. C. L. Wadhwa, 'Generation Distribution and Utilization of Electrical Energy', New Age International, 4th Edition, 2011.

Supplementary Readings

1. S. L. Uppal and S. Rao, 'Electrical Power Systems', Khanna publishers: New Delhi, 1 st Edition, 2009.
2. J. B. Gupta, 'Utilisation of Electrical Energy and Electric Traction', S. K. Kataria and Sons, 10th Edition, 1990.
3. E. Openshaw Taylor, Utilization of Electric Energy, Universities Press, 12th Edition, 2009

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE316	**Power Electronics for Electric Propulsion**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- Identify the specification of Power Electronics devices for any propulsion application
- Study the control technique of Power Electronic converter for different drive system.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE316.1	To understand different converter operation for drives	Knowledge Application
EE316.2	To control the PWM pulses of inverters as per the motor drives requirement.	Comprehension Synthesis
EE316.3	To develop the converter circuit for high power applications.	Application Analysis
EE316.4	To understand the operation of chopper circuit for motor drive application.	Comprehension Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE316.1	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**2**	**1**	**2**
EE316.2	**3**	**1**	**2**	**1**	**2**				**2**			**3**	**2**	**1**	**2**
EE316.3	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**2**	**1**	**2**
EE316.4	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**2**	**1**	**2**
EE316	**3.00**	**1.75**	**2.00**	**1.00**	**2.00**	**1.00**	**1.00**		**2.00**			**3.00**	**2.00**	**1.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
I	**Power Electronics Converter for drives** Schematic overview of applied power electronics converters, switching converters and their application to variable frequency drives, Amplitude control, Frequency control, Converter development in relation to electromagnetics, EMI/EMC	**10**	**CO1**
II	**Pulse width Modulation for Electronic Power converters** Introduction, Power Amplification, Space vectors, performance criteria, open loop schemes, closed loop PWM control, Multilevel converters, Current source inverter.	**10**	**CO2**
III	**High Power Drives** Introduction, Classification with speed and power ratings, converters for large drives, synchronous motor fed by externally commutated current source converters, Induction motor fed by current source inverters, Cycloconverter fed synchronous motor, large voltage source inverter drives.	**12**	**CO3**
IV	**Chopper controlled dc motor drive** Introduction, Chopper for inversion, Chopper with other power devices, Model of the chopper, Steady state analysis of Chopper controlled DC motor drive, Rating of the devices,	**10**	**CO4**
Total Hours		**42**	

Essential Readings

1. B. K. Bose "Power Electronics and variable frequency drives technology and applications" Willey, 1st edition, 2014
2. M. H Rashid, "Power Electronics Circuits, Devices, and Applications", Prentice-Hall of India Pvt. Ltd, 3rd Edition, 2014

Supplementary Readings

1. M. Ned and T. M. Undeland, "Power Electronics Converters Applications and Design", John Willey Inc, 3rd Edition, 2002.
2. P. S. Bimbhra, "Power Electronics", Khanna Publishers, 5th edition, 1990.
3. L. Umanand, "Power Electronics Essential and Applications", Willey, 1st Edition, 2009.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE318	**Advanced Digital Signal Processing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To acquire fundamental knowledge of signal operation in digital domain and frequency transform methods	Course Outcomes	EE318.1	Able to understand the concept of digital signal processing, and frequency transform concepts to implement digital filters	Knowledge Understand Apply
	To learn skills and design various methods digital signal processing strategies		EE318.2	Learn multirate signal processing strategies and design filter bank, adaptive signal processing	Apply, analyse evaluate
			EE318.3	Apply frequency domain analysis based on short time frequency transform, wavelet transform techniques, speech signal processing	Apply, evaluate
			EE318.4	Employ parametric methods for power spectrum estimation	Analyze
			EE318.5	Integrate FPGA and hardware processor for digital signal processing	Apply, Crete

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE318.1	**3**	**3**		**1**		**1**			**1**			**1**	**3**		**3**
EE318.2	**3**	**3**		**1**		**1**			**1**			**1**	**2**		**2**
EE318.3	**2**	**3**	**3**	**1**	**2**	**1**						**1**	**2**	**3**	**2**
EE318.4	**2**	**2**	**3**		**2**	**2**			**1**			**1**	**2**	**3**	**2**
EE318.5	**2**	**2**	**3**		**2**	**2**			**1**			**1**	**3**	**3**	**3**
EE318	**2.4**	**2.6**	**3**	**1**	**2**	**1.4**			**1**			**1**	**2.2**	**3**	**2.2**

SYLLABUS

No.	Content	Hours	COs
I	**Filter Design** Digital filter design techniques, Basic concepts of IIR and FIR filters, difference equations, design of Butterworth IIR analog filter using impulse invariant and bilinear transform, design of linear phase FIR filters, transformation of digital filters, FIR filter design using windows, MATLAB based examples.	**09**	**CO1**
II	**Multirate DSP** Introduction to multirate DSP, decimation and interpolation, polyphase decomposition, uniform DFT filter banks, quadrature mirror filters and perfecter construction	**08**	**CO2**
III	**Adaptive Signal Processing** FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares.	**07**	**CO2**
IV	**Wavelet Transforms** Fourier Transform: Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition – Haar Wavelet – Daubechies Wavelet. **Speech Signal Processing** Digital models for speech signal: Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.	**06**	**CO3**
V	**Parametric Methods for Power Spectrum Estimation** Discrete random signals, power spectral density and properties, spectral estimation methods. Relationship between the auto correlation and the model parameters – The Yule – Walker method for the AR Model Parameters – The Burg Method for the AR Model parameters – unconstrained least-squares method for the AR Model parameters – sequential estimation methods for the AR Model parameters – selection of AR Model order.	**06**	**CO4**
VI	**Digital Signal Processor** Elementary idea about the architecture and important instruction sets of TMS320C 5416/6713 processor, writing of small programs in assembly Language. Architecture, different sub-systems, design flow for DSP system design, mapping of DSP alrorithms onto FPGA.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach," Tata McGraw-Hill.
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education.
3. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing," PHI.
4. Tamal Bose, "Digital Signal and Image Processing" Wiley Publication, 2010
5. Tarun Kumar Rawat, "Digital Signal Processing," Oxford University Press, 2015.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 322	**Energy Management and Auditing**	**--------**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- ❖ To understand the basics of energy sources and their utilization.
- ❖ To create awareness about sources of energy and able to estimate how long the available conventional fuel reserves will last.
- ❖ To understand the various renewable energy sources and their applications.
- ❖ To understand energy management strategies and challenges of integrating renewables into the electric grid.
- ❖ To understand the importance of energy sources and their utilization.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE 322.1	To understand the primary sources of energy and nonconventional energy sources and their primary applications in India and the world.	Knowledge, Identification & Application
EE 322.2	To gain knowledge on exploiting non-conventional and renewable energy sources; like solar and wind energy.	Knowledge, Identification & Application
EE 322.3	To understand bioenergy, Hydel Energy, and Nuclear Energy	Knowledge & Application
EE 322.4	To understand the Energy Storage system and Ocean Thermal Energy Conversion & Tidal Energy	Identification & Application
EE 322.5	To understand energy audit and management system.	Knowledge Identification Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE 322.1	**3**	**1**		**1**		**1**	**3**	**1**					**3**		**1**
EE 322.2	**3**	**3**	**1**	**1**		**1**	**3**	**1**					**3**		**1**
EE 322.3	**3**	**3**	**2**	**2**	**1**	**1**	**3**	**1**					**3**	**3**	**1**
EE 322.4	**3**	**2**	**3**	**2**	**1**	**1**	**3**	**1**					**3**	**2**	**1**
EE 322.5	**3**	**1**	**3**	**3**	**1**	**1**	**3**	**1**					**3**	**1**	**2**
EE 322	**3.00**	**2.00**	**2.25**	**1.80**	**1.00**	**1**	**3**	**1**					**3.00**	**2.00**	**1.40**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction To Energy Resources** Energy, Energy resources and forms of energy, Energy demand, World energy resources, Indian energy scenario, environmental aspects of energy utilization, Non-Conventional Energy Resources, renewable energy resources and their importance, Energy Management, Energy crisis, Environmental aspects.	**05**	**CO1**
II	**Solar Energy and Photovoltaic Systems** Introduction, nature of solar energy, solar cell energy conversion, efficiency, characteristics, effect of variation of solar insolation and temperature, Local apparent time, methods of calculation, losses, components of PV systems, solar PV power plants, V-I characteristics of solar cell, PV cell technology, Solar-thermal systems, Hybrid power plant. **Wind Energy** Overview, Power in wind, Aerodynamics, Types of turbine, wind turbine blade, Various aspects of wind turbine design, Power coefficients Vs. Tip speed ratio for various turbine, Wind power conversion technologies, , Wind turbine generators: induction, synchronous machine, Constant V & f and Variable V & f generations.	**08**	**CO2**
III	**Bio Energy:** Introduction, Availability, Conversion processes, Biogas generation, , Anaerobic digestion, factors affecting biogas generation, Thermochemical conversion, Biochemical conversion, Fermentation, Types of biogas plant, Biogas scenario in India. **Hydel Energy:** Classification of hydel plants, Concept of micro hydel, MHP plants: components, design and layout, turbines, efficiency, status in India. **Nuclear Energy:** International nuclear energy policies and regulations, nuclear energy technologies –fuel enrichment, different types of nuclear reactors, nuclear waste disposal, and nuclear fusion.	**10**	**CO3**
IV	**Energy Storage & Fuel Cells:** Introduction, Battery energy storage system, Compressed air energy storage, Superconducting magnet energy storage, Fuel cell power sources, Electrical circuits, Performance characteristics, Prospects of fuel cell power plants. **Ocean Thermal Energy Conversion & Tidal Energy:** Introduction, off-shore & On-shore ocean energy conversion, Principle of OTEC power plants, India's first OTEC plant, Wave energy, Tidal power plants, Classification, advantages & limitations.	**07**	**CO4**
V	**Energy Management and Audit System:** EMS, Energy Audit & types, Energy crisis, Energy planning, Energy exploited & energy demand, Energy demand management, End-use energy consumption profile.	**05**	**CO5**
	Total Hours	**36**	

Essential Readings

1. Andrews J, Jelley N, "Energy Science", Oxford University Press, 3 rd edition, 2017.
2. Godfrey Boyle, "Renewable Energy", Oxford University Press, 3 rd Edition, 2012.
3. S. Rao, B.B. Parulekar, "Energy Technology", Khanna Publishers, 3rd Edition, 2018 (Reprint)

Supplementary Readings

1. D.P. Kothari, K.C. Singal, R. Ranjan, "Renewable Energy Sources and Emerging Technologies" 2nd Edition, PHI, 2011.
2. G.D. Rai, "Non-Conventional Energy Sources, Khanna Publishers, 6th Edition, 1988.

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Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE324	**Robotics and Control: Theory and Practice**	**------**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To introduce kinematics of different robotic manipulators		EE324.1	**Able to acquire kinematics knowledge about different robotic manipulators and identification of its industrial application**	Knowledge Identification Application
	To teach the robotic exoskeletons system and their modeling		EE324.2	**Able to acquire knowledge about robotic exoskeleton systems, their modeling and application**	Knowledge Application
	To develop ability and skill about robotics control design		EE324.3	**Able to design of robotics control**	Design
	To develop ability to apply robotics control design for human finger		EE324.4	**Able to design of robotics control for human finger**	Design
	To introduce basic skill about smart robotics		EE324.5	**Able to acquire knowledge about smart robotics and its application**	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE324.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE324.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE324.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**2**			**2**	**3**	**3**	**3**
EE324.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE324.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE324	**2.0**	**2.4**	**2.6**	**2.25**	**2.0**	**1.8**	**1.6**	**1.0**	**2.0**			**2.0**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Simple manipulators: Two /three arm manipulators and their kinematics equations, Workspace Homogeneous Transformation: Rotation, Translation, Composition of homogeneous transformations. Danavit-Hartimber Algorithm: D-H procedure for fixing joint coordinate frames, Robot parameters, Arm matrix, Inverse Kinematics for PUMA, SCARA manipulators.	**09**	**CO1 CO2**
II	Introduction to Robotic Exoskeletons, Optimal Design of a Three Finger Exoskeleton for Rehabilitation Purpose. Differential transformation and velocity of a frame: Derivative of a frame, Velocity, Jacobian, Inverse Jacobian, Trajectory Planning: Polynomial trajectory, Biped trajectory	**10**	**CO2 CO3**
III	Dynamics: Lagrangian method, Robot dynamics equation, Control: Robot dynamics equation as a control system, Trajectory tracking control, PD controller, Neural network control design	**09**	**CO3**
IV	Redundancy Resolution of Human Fingers using Robotic Principles, Manipulability Analysis of Human Fingers during Coordinated Object Rotation, Kinematics of Flexible Link Robots	**07**	**CO4**
V	Robot Assisted Needling System for Percutaneous Intervention-An Introduction, Smart Robotic Needles for Percutaneous Cancerous Interventions. Robust Force Control of a Two Finger Exoskeleton during Grasping, Neural Control of an Index Finger Exoskeleton	**07**	**CO5**
Total Hours		**42**	

Essential Readings

1. Richard Paul, Robot Manipulators: Mathematics, Programming and Control, MIT Press, 1981
2. Robert Shilling, Fundamentals of Robotics, Prentice-Hall, 2003
3. Laxmidhar Behera and Indrani Kar, “Intelligent Systems and Control”, Oxford University Press, Nov 2009.

Supplementary Readings

1. M. Felix Orlando, Ashish Dutta, Anupam Saxena, Laxmidhar Behera, Tomoya Tamei and Tomohiro Shibata, “Manipulability Analysis of Human Thumb, Index and Middle Finger in Cooperative 3D Rotational Movements of a Small Object”, Robotica, vol. 31, pp. 797-809, 2013.
2. M. Felix Orlando, Laxmidhar Behera, Tomayo Tamei, Tomohiro Shibata, Ashish Dutta and Anupam Saxena," On Redundancy Resolution of the Human Thumb, Index and Middle Fingers in Cooperative Object Translation," Robotica, vol. 35, pp. 1992-2017, 2016.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE326	**Operation and Planning of Power Distribution Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
To understand an overview of modern power distribution systems penetrated with DGs.		EE326.1	**Able to acquire knowledge about modern power distribution systems.**	Knowledge
To learn about reactive power compensation in the distribution network.		EE326.2	**Able to acquire knowledge about the features of distribution systems.**	Knowledge
To understand different planning methods of distribution networks.		EE326.3	**Able to understand the reliability indices used in distribution networks**	Understand
		EE326.4	**Able to develop load flow model for radial distribution networks and understand reactive power compensation**	Develop Understand
		EE326.5	**Able to understand the distribution system planning and reconfiguration of the network.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE326.1	**3**	**3**	**2**		**1**								**3**		**1**
EE326.2	**3**	**3**	**3**	**2**	**1**								**3**		**1**
EE326.3	**3**	**3**	**3**	**3**	**3**			**1**					**3**		**2**
EE326.4	**3**	**3**	**3**	**3**	**3**			**1**					**3**		**3**
EE326.5	**3**	**3**	**3**	**3**	**3**			**1**					**3**		**3**
EE326	**3**	**3**	**2.8**	**2.2**	**2.2**			**0.6**					**3**		**2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Power systems overview and historical developments, Introduction to power delivery systems, Introduction to electrical loads, Load diversity, Different load indices, Loss factor.	**06**	**CO1**
II	**Basic features of distribution systems:** Load management, Brief overview of power distribution substation, Substation bus schemes and primary distribution network topology, Voltage drop and power loss computations for typical radial distribution feeders, Generalized expression for voltage drop for radial distribution feeder, Derivation of K-constant for voltage drop computation.	**07**	**CO2**
III	**Reliability assessment:** Different reliability indices used in distribution networks, Different reliability indices with numerical examples, Mathematical concept of reliability, Reliability evaluation of multiple units connected to series and/or parallel, Numerical problems on reliability evaluation, Power quality problems in distribution systems	**07**	**CO3**
IV	**Load flow in distribution networks:** Forward-backward load flow approach for power distribution systems, flow-chart of the forward-backward, bus data file preparation, implementation of load flow for different sizes of radial distribution networks.	**06**	**CO4**
V	**Reactive power compensation:** Basic concept, different compensation techniques, power factor improvement, economic power factor, computerized method to determine economic power factor, capacitor placement at distribution feeder (analytical approach), other reactive power compensating devices.	**06**	**CO4**
VI	**Distribution system planning and reconfiguration:** Introduction, different model and solution strategies, classification of distribution planning, single objective/multi-objective problem formulation, planning by incorporating sectionalizing switches and tie-lines, reconfiguration of distribution networks, distribution networks integrated with distributed generations, microgrid concept.	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. T. Gonen. *Electric Power Distribution System Engineering*; CRC Press, 3rd Edition, 2014
2. H. Lee. Willis. *Power Distribution Planning Reference Book*; CRC press; 2nd Edition, Revised and Expanded, 2004
3. A. S. Pabla, *Electric Power Distribution*; Tata Mcgraw-Hill Publishing Company Ltd., 5th Edition, 2007.

Supplementary Readings

1. Math Bollen and Fainan Hassan, *Integration of Distributed Generation in the Power System*; IEEE Press, 2011
2. R. Billington and R. Allan, *Reliability Evaluation of Power Systems*; Springer, Berlin, 2nd Edition, 1996.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE 328	**HVAC & HVDC Transmission Systems**	**EE 151**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	❖ To understand the High Voltage power transmission system.		EE 328.1	Able to understand the usage of EHVAC and HVDC transmission systems.	Knowledge, Identification & Application
	❖ To understand the HVAC & HVDC power transmission system.		EE 328.2	Able to analyse EHVAC transmission system	Knowledge, Identification & Application
	❖ To analyse the EHVAC power transmission system.		EE 328.3	Able to analyse HVDC transmission system	Knowledge & Application
	❖ To analyse the HVDC power transmission system.		EE 328.4	Able to design EHVAC & HVDC system	Identification & Application
	❖ To analyse the operation and maintenance.		EE 328.5	Able to understand the Operation and Maintenance of EHVAC and HVDC Systems	Knowledge Identification Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE 328.1	**3**	**2**		**1**									**1**		**2**
EE 328.2	**3**	**2**	**1**	**1**									**3**		**2**
EE 328.3	**3**	**2**	**2**	**1**	**1**								**2**	**1**	**2**
EE 328.4	**3**	**2**	**3**	**1**	**1**								**3**	**1**	**2**
EE 328.5	**3**	**2**	**3**	**1**	**1**								**2**	**1**	**2**
EE 328	**3.00**	**2.00**	**2.25**	**1.00**	**1.00**								**2.40**	**1.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** High voltage power transmission system, EHVAC transmission, HVDC transmission, and interconnected networks.	**06**	**CO1**
II	**EHVAC Power Transmission System** Line and ground parameters, Corona, Radio interference, Real and reactive power flow, reactive power compensation, FACTS, short circuit level & real power transfer capacity; Power–frequency voltage control, Overvoltage, and Insulation coordination.	**08**	**CO1, CO2**
III	**HVDC Power Transmission System** HVDC converters, control and its characteristics, harmonics and its mitigation, protection issues in the HVDC system, and overvoltage and insulation coordination.	**08**	**CO3**
IV	**Design of EHVAC and HVDC** Design of Transmission line, tower, insulator, and substation, and power cables; Design based on steady-state limits and transient overvoltage.	**08**	**CO4**
V	**Operation and Maintenance of EHVAC and HVDC Systems:** **EHVAC System Operation and Maintenance:** Maintenance schedules and procedures, Condition monitoring and diagnostics, Failure modes and effects analysis (FMEA), Asset management and lifecycle assessment, Case studies on EHVAC system maintenance **HVDC System Operation and Maintenance:** Routine and preventive maintenance, Diagnostic techniques and tools, Managing and mitigating operational risks, Component reliability and maintenance strategies, Case studies on HVDC system operation, and troubleshooting.	**06**	**CO5**
	Total Hours	**36**	

Essential Readings

1. S. Rao, 'EHV-AC, HVDC Transmission, and Distribution Engineering, Khanna Publishers, 3rd Edition, 2012.
2. S. K. Sharma, "EHV-AC, HVDC Transmission and Distribution Engineering," S. K. Kataria & Sons, 2nd Edition, 2016.

Supplementary Readings

1. Rakosh Das Begamudre, 'Extra High Voltage AC Transmission Engineering,' New Age International Publishers, 3rd Edition, 2009.
2. Padiyar K.R., 'HVDC Transmission Systems', New Age International Publishers, 2nd Revised Edition, 2012.
3. S. Kamakshaiah & V. Kamaraju, "HVDC Transmission", McGraw Hill Education, 1st edition, 12th reprint, 2018.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE332	**Modern Radar Systems**	------	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		CO's	Statement	Bloom's Taxonomy
	To introduce basic principles of microwave Radars			EE332.1	**Able to acquire knowledge about different microwave Radar and its application**	Knowledge Application
	To teach different analysis approaches of Radar system			EE332.2	**Able to acquire knowledge and application about different analysis approaches of Radar system**	Knowledge Application
	To develop ability and skill to design Radar for imaging application			EE332.3	**Able to design Radar for imaging application**	Design
	To introduce Radar design skill for sensing and microwave imaging			EE332.4	**Able to design Radar for sensing and microwave imaging**	Design
	To introduce principles and technologies about emerging and modern applications of Radar			EE332.5	**Able to acquire knowledge and application about emerging and modern Radar technologies**	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE332.1	**3**	**3**	**2**	**1**					**2**				**3**	**2**	**3**
EE332.2	**3**	**3**	**2**	**1**					**2**				**2**	**2**	**2**
EE332.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**		**1**			**2**	**2**	**3**	**2**
EE332.4	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE332.5	**2**	**2**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE332	**2.4**	**2.6**	**2.6**	**1.2**	**2**	**2**	**2.67**		**1.8**			**1.33**	**2.6**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Basic Principles: Radar equation, Radar Cross section, CW Radar, FMCW Radar, Pulsed Radar Principles	**08**	**CO1**
II	Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar. Tracking Radar, Angular resolution, Monopulse Technique. Detection Theory: Match Filtering, Radar Ambiguity Function	**09**	**CO2**
III	Imaging Radar: Resolution Concept, Pulse Compression. Synthetic Aperture Processing, ISAR Imaging. Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models	**09**	**CO3**
IV	Ground Penetrating Radar for close sensing, Radar Tomography and Radar based Microwave Imaging	**07**	**CO4**
V	Emerging and Modern Applications of Radar Principles and Technologies	**09**	**CO5**
	Total Hours	**42**	

Essential Readings

1. M. I. Skolnik, Introduction to Radar Systems, 3rd Edition, Tata Mcgraw Hill Edition, 2001.
2. B. R. Mahafza, Radar Systems Analysis and Design using MATLAB, 3rd Edition, CRC Press, 2013
3. S. M. Sherman and D. K. Barton, Monopulse Principles and Techniques, 2nd Edition, Artech House, 2011.

Supplementary Readings

1. M. A. Richards, Fundamentals of Radar Signal Processing, Tata Mcgraw Hill, 2005.
2. H. M. Jolt (Editor), Ground Penetrating Radar: Theory and Applications, Elsevier, 2009.
3. M. Pastorino, Microwave Imaging, John Wiley, 2010.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE336	**Biomedical Instrumentation**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To explore the roles of Engineering in Healthcare systems	Course Outcomes	EE336.1	Ability to enhance basic understand about the origin of various biomedical signals and to understand the signal conditioning circuits and data acquisition process	Knowledge Understand Apply
	To acquire knowledge about various biomedical sensors, transducers, instruments and their applications in measurement and diagnosis of physiological variables for better healthcare technologies.		EE336.2	Ability to comprehend various sensors and physiological transducers used for biomedical applications	Understand Apply Analyze
	To enhance the knowledge of data acquisition and biomedical transducer to perform PC based measurements.		EE336.3	Ability to develop an understanding of the recent trends in measurement and recording principles of various medical instruments	Analyze
	To develop an understanding of the patient safety related to the medical instruments				
	To understand the basics of data acquisition and recording of various biomedical signals				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE336.1	**3**	**3**		**1**	**3**			**1**	**2**			**1**	**3**		**3**
EE336.2	**3**	**3**	**2**	**2**	**3**			**1**	**2**			**1**	**3**	**3**	**2**
EE336.3	**2**	**3**	**3**	**1**	**1**	**1**	**2**						**2**		**2**
EE336	**2.66**	**3**	**2.5**	**1.33**	**2.33**	**1**	**2**	**1**	**2**			**1**	**2.33**	**3**	**2.66**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1: Bio-Electric Signals and Electronics** Origin of bio-electric signals, Basis of bioelectric signals: Electrocardiogram, Electroencephalogram, Electromyogram. Bioelectric potentials, Biopotential electrodes. Biomedical amplifiers. Principles of recording for bioelectric events	**11**	**CO1**
II	**Module 2: Physiological Transducers** Roles of Engineering in Healthcare systems. Problems encountered in measuring physiological parameters. Fundamentals of Transducers for biomedical applications. Various types of transducers: variable resistance transducers, variable inductance transducers, variable capacitance transducers, thermosensitive transducers, photoelectric transducers, piezoelectric transducers for measurement of different physiological parameters and their selection for medical applications	**11**	**CO2**
III	**Module 3: Bio-Medical Instrumentation System** Generalized Medical Instrumentation System, Instrumentation for the clinical laboratory, Instrumentation for diagnostic X-ray, Basic principles of instruments and devices for Electrocardiogram, Electroencephalogram, Electromyogram and audiometer. PC based biomedical instrumentation.	**10**	**CO3**
IV	**Module 4: Recent Trends** Medical imaging, X-rays, laser applications in biomedical field, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy, PET SCAN, MEMS applications in biomedical field, Prosthetic devices (artificial limbs) and therapies.	**10**	**CO3**
	Total Hours	**42**	

Essential Readings

1. L. Cromwell, Biomedical Instrumentation and Measurements, Pearson Education India, Second Edition, 2015.
2. R. A. Natarajan, Biomedical Instrumentation and Measurements, Prentice-Hall of India Pvt. Ltd, Second Edition, 1990.
3. J. G. Webster, Medical Instrumentation: Application and Design, Wiley India, Fourth Edition, 2009.

Supplementary Readings

4. R. Aston, Principles of Biomedical Instrumentation and Measurement, Pearson Prentice Hall, First Edition, 1990.
5. R. S. Khandpur, Handbook of Biomedical Instrumentation, McGraw Hill Education, Third Edition, 2014.
6. J. Bronzino, Biomedical Engineering & Instrumentation, PWS Engg: Boston, Third Edition, 1986.
7. J. Enderle, Bioinstrumentation, Morgan & Claypool Publisher, Second Edition, 2006.
8. A. Richard , Principles of Bio-medical Instrumentation and Measurement, Merril Publishing Company: New York, Second Edition, 2002.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE338	**Unmanned Aerial Vehicles**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To introduce fixed-wing Unmanned Aerial Vehicles (UAVs)		EE338.1	**Able to acquire knowledge about fixed-wing UAVs and identification of design parameters**	Knowledge Identification
	To teach the design algorithms of fixed-wing UAVs		EE338.2	**Able to acquire knowledge about design algorithms of fixed-wing UAVs and its application**	Knowledge Application
	To develop ability and skill for parameter estimation and stability analysis of UAVs		EE338.3	**Able to estimate parameter and compute stability of UAVs system**	Estimate Compute
	To develop skill to design UAVs for 3D Mapping using Stereo vision system		EE338.4	**Able to design UAVs for 3D Mapping using Stereo vision system**	Design
	To develop skill to design Flapping Wing Vehicle (FWV) and Image based control of flocking of birds		EE338.5	**Able to design Flapping Wing Vehicle (FWV) and Image based control of flocking of birds**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE338.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE338.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE338.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
EE338.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE338.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE338	**2.00**	**2.40**	**2.60**	**2.25**	**2.00**	**1.80**	**1.60**	**1.00**	**2.00**			**2.00**	**2.60**	**2.75**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to fixed-wing Unmanned Aerial Vehicles (UAVs), Introduction to Design, Basic Design Parameters, Design Algorithm: Case Study, Design Algorithm: Mission Requirements	**08**	**CO1**
II	Design Algorithm: Feasible Design Parameters, Configuration Layout: Airfoil Selection, Configuration Layout: Planform Geometry selection, Weight and CG Estimation,	**08**	**CO2**
III	Analytical Parameter Estimation, Performance and Stability Analysis. Detailed Sizing of UAVs, Estimation of inertial properties using 3D modelling. Wind Tunnel Testing, Aerodynamic Characterization through Wind Tunnel Testing	**10**	**CO3**
IV	**Case study:** SWARM of UAVs for 3D Mapping using Stereo vision system Stereo Vision Camera: Working Principle, Capturing of Point Cloud Data: Indoor and Outdoor Environment, Image Stitching: 3D Mapping. Path Planning Algorithms, Simulation Studies, Implementation of Developed Algorithm in UAV, Testing, Obstacle Avoidance. SWARM of UAVs: Simulation Studies, Line and Triangle Formation of UAVs: Demonstration Videos with UAV, Theoretical an Experimental Comparison.	**06**	**CO4**
V	**Case study:** Development of Flapping Wing Vehicle (FWV) and Image Based Control of Flocking of Birds Flapping Wing Vehicle: Introduction, Lift and Drag Forces, Birds Motion, Angle of Attack, Measurement of Lift and Thrust Forces, Mechanism Design of FWV, Manufacturing of Micro Mechanism Components: Injection Moulding, Wire Cut EDM, 3D Printing, Selection and Assembly of FWV Components, Image Based Control of Group of FWVs: Demonstration Videos with FWV.	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. John D. Anderson, Introduction to Flight, McGraw-Hill, 1945.
2. Bandu N. Pamadi, Performance, Stability, Dynamics, and Control of Airplanes, American Institute of Aeronautics and Astronautics Publishing Company Inc., 2015.
3. John D. Anderson, Aircraft performance and design, Tata McGraw-Hill, 2010.

Supplementary Readings

1. Mohammad H. Sadraey, Unmanned Aircraft Design: A review of fundamentals, Springer Cham, 2017.
2. J. Gundlach, Designing Unmanned Aircraft Systems: A comprehensive Approach, American Institute of Aeronautics and Astronautics Publishing Company Inc., 2012.
3. A. J. Keane, A. Sóbester, J. P. Scanlan, Small Unmanned Fixed-wing Aircraft Design: A Practical Approach, John Wiley & Sons Ltd, 2017.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE372	**Autonomous Drone Technology**	-----	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To introduce DGCA regulation and classifications, applications, payloads of UAV/ Drone**	EE372.1	**Able to acquire knowledge about classifications, applications and payloads of UAV/ Drone**	Knowledge Application
	To teach the aerodynamics and computational fluid dynamics of UAV/ Drone	EE372.2	**Able to acquire knowledge about aerodynamics and computational fluid dynamics of UAV/ Drone and application**	Knowledge Application
	To develop ability and skill in design, assembly, integration and testing of Drone (Quadcopter)	EE372.3	**Able to apply skills of design, assembly, integration and testing in drone (Quadcopter)**	Apply
	To develop ability to use the drone in industrial and engineering applications	EE372.4	**Able to use the drone in industrial and engineering applications**	Use
	To develop ability and skill about amphibious drone for water quality monitoring	EE372.5	**Able to design of amphibious drone for water quality monitoring**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE372.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE372.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE372.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
EE372.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE372.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE372	**2.00**	**2.40**	**2.60**	**2.25**	**2.00**	**1.80**	**1.60**	**1.00**	**2.00**			**2.00**	**2.60**	**2.75**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction, Classifications, Applications and Payloads of UAV/ Drone** Motivation, Types of UAV, Characteristics, Fixed Wing, Rotary Wing, Flapping Wing, Basic Parts of UAV, Specifications, Applications, Pay loads of UAV. **DGCA Rules & Regulation** Drone Categories Based on All-up weight, Type Certification of UAVs, DGCA Rules for UAV Registration, Certification and Pilot Licensing, Remote Pilot Training Organization (RPTO), Flying Zones	**05**	**CO1**
II	**Aerodynamics and Computational Fluid Dynamic Analysis of UAV/ Drone** Basics of Aerodynamics, Lift and Drag, Bernoulli Theories and Equations, Angle of Attack, Peculiarities of Multicopters, Wing Tip Vortices and Wake Turbulence, Stability, Turning Flight, Stall. Introduction to CFD – Fluid Governing Equations, Turbulence Models, External and Internal Flows, Modeling and Aerodynamic Analysis	**06**	**CO2**
III	**Design, Assembly, Integration and Testing of Drone (Quadcopter)** Design of Quadcopter, Selection of Sub Systems, Airframe Assembly, Integration of Electronic Systems, Firmware Loading and Parameter Set up, Calibration of Sensors, Tuning. Introduction to Ground Control Station, Autonomous Flight Path Planning, Testing of Quadcopter	**06**	**CO3**
IV	**Industrial and Engineering Applications of Drone** Need of UAVs/Drones for Industrial Applications, Development of Drones for Powerline Inspection, Telecom Structure Inspection and Radiation Measurement, Bridge and Heritage Structure Inspection, Collection of Sea Weeds using Drone.	**06**	**CO4**
V	**Case Study: Amphibious Drone for Water Quality Monitoring** Conceptual Designs of Amphibious Drone, Design Parameters, CFD and FEA Analysis, Subsystems of Amphibious Drone, Selection of Components, Fabrication, Testing of Sub Systems, Integration of Sub Systems, Real Time Testing of Developed Amphibious Drone, Water Quality Sensors, Collection of Water Quality Data using IoT Platform.	**05**	**CO5**
	Total Hours	**28**	

Essential Readings

1. R. Austin, Unmanned aircraft systems: UAVs design, development and deployment. John Wiley & Sons, 2011.
2. P. Fahlstrom, T. Gleason, Introduction to UAV systems, 4th Edition, Wiley, UK, 2012.
3. D. Norris, Build your own quadcopter. McGraw-Hill Education, New York, 2014.

Supplementary Readings

1. Y. B. Sebbane, A first course in aerial robots and drones. CRC Press, 2022.
2. L. J. Yang, B. Esakki, Flapping Wing Vehicles: Numerical and Experimental Approach. CRC Press, 2021.
3. K. P. Valavanis, G. J. Vachtsevanos (eds), Handbook of unmanned aerial vehicles, Springer, 2015.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
VA302	**Indian Knowledge System**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the Vedas and Upaniṣads, exploring their structure, the Gurukul system, and philosophical themes such as Ṛta, Ṛna, Puruṣārtha, Varṇa Dharma, Brahman, Ātman, and Mokṣa.**	Course Outcomes	VA302.1	**Able to acquire knowledge about the structure and philosophical themes of the Vedas and Upaniṣads, including Ṛta, Ṛna, Puruṣārtha, Varṇa Dharma, Brahman, Ātman, and Mokṣa**	Knowledge Identification Application
	To teach the essence of Indian knowledge through the Bhagavadgītā, covering Jñānayoga, Karmayoga, Bhaktiyoga, Niskāma Karma ethics, the Law of Karma, Svadharma, Sādharana Dharma, Lokasaṁgraha, and Sthitaprajña.		VA302.2	**Able to gain insights into the ethical and philosophical concepts such as Ṛta, Ṛna, Puruṣārtha, and Varṇa Dharma.**	Knowledge Identification
	To introduce Indian philosophical systems and their scientific aspects, including the characteristics of Indian philosophy, Pramānas, Orthodox and Heterodox schools, and insights into ancient Indian science and technology.		VA302.3	**Able to identify and differentiate Indian philosophical systems, including Orthodox and Heterodox schools, and appreciate their scientific aspects.**	Identification Design
	To provide an overview of Yoga and Ayurveda, tracing the origins of Patanjali Yoga, exploring the relevance of Ayurveda, and advocating an integrated approach to holistic healthcare.		VA302.4	**Able to identify the origins of Patanjali Yoga and understand its relevance in holistic health care.**	Identification

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VA302.1		**1**	**1**	**1**				**3**				**3**			
VA302.2		**1**		**2**				**3**				**2**			
VA302.3		**1**		**1**				**1**				**3**			
VA302.4		**1**		**1**				**3**				**2**			
VA302		**1**	**1**	**1.2**				**2.5**				**2.5**			

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to the Vedas and Upaniṣads:** The general structure of the Vedic Literature, Gurukul System of Vedic times (Aṣrama Dharma), General Introduction of Upaniṣadic Literature, Philosophical Ideas and Ethics in Upaniṣads, Ṛta, Ṛna, Puruṣārtha, Varṇa Dharma, Brahman and Ātman, Mokṣa.	**06**	**CO1**
II	**Essence of Indian Knowledge** Bhagavadgītā: Jñānayoga, Karmayoga and Bhaktiyoga, Ethics of Niskāma Karma, Law of Karma (Karma-phala) and Freedom of Will, Svadharma, Sādharana Dharma, Lokasaṁgraha, Sthitaprajña.	**08**	**CO2**
III	**Introduction to Indian Philosophical Systems, Scientific aspects of Indian Knowledge Systems:** Characteristics of Indian Philosophy, Distinction between Darśana and Philosophy, Pramānas, General Introduction to Indian Philosophical systems, i.e. Orthodox and Heterodox, Glimpses of Ancient Indian Science and Technology.	**06**	**CO3**
IV	**Introduction to Yoga and Ayurveda:** Origin and development of Patanjali Yoga, Ayurveda and its Relevance, Integrated Approach to Holistic Health Care.	**08**	**CO4**
Total Hours		**28**	

Essential Readings

1. Chakravarthy, G.N. The Concept of Cosmic Harmony in the Rg-Veda. Bangalore: Nagasri Book House, 2005.
2. Chande, M. B. Indian Philosophy in Modern Times. New Delhi: Atlantic Publishers, 2000.
3. Chatterjee, Satish Chandra & D.M Dutta. An Introduction to Indian Philosophy. Kolkata: Rupa and co., 2010.
4. Gambhirananda, Swami. Bhagavad-Gita with the Commentary of Sankaracarya. Advaita Ashrama, Kolkata, 2018.

Supplementary Readings

1. Gambhirananda, Swami. Eight Upanishads: With the Commentary of Shankaracharya. Advaita Ashrama, Kolkata, 2010.
2. Panda, N. C. Bhagavad Gita: A New Exposition in a Broader Spectrum. New Delhi: D.K. Print world Ltd. 2009.
3. Radhakrishnan, S and J. H. Muirhead (ed.), Contemporary Indian Philosophy. George Allen & Unwin Ltd., 1952.

	National Institute of Technology Meghalaya An Institute of National Importance		MAPPING & EVALUATION SCHEME
Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C		MID	END	Total
EE382	**Minor Project-2**	**0**	**0**	**4**	**2**		**30/100**	**70/100**	**100**

			COs	Statement
		After the completion of the course, the student should be able to:		
Course Objectives	**To introduce the basic concepts for preparing proposal on engineering and technology**	**Course Outcomes**	EE382.1	**Use critical and creative thinking to prepare proposal on engineering and technology**
	To teach the use modern engineering tools model, fundamental knowledge, and skills to develop methodology or prototype		EE382.2	**Design the system components and use the appropriate modern engineering tools**
	To develop skills to prepare and present the technical report and present via power point presentation		EE382.3	**Apply fundamental knowledge and skills to develop methodology or prototype as a team**
			EE382.4	**Incorporate the suggestions made to improve the project quality for societal and environmental contexts**
			EE382.5	**Demonstrate the project and prepare technical report as a team**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE382.1	1	3	3		3		3	2	3	3	3	3	3	3	2
EE382.2	3	3	3		2		3	3	2	3	3	2	2	3	3
EE382.3	2	1	1	3	1	2	1				2	3	2	3	3
EE382.4	3			3	2	3	2			2	1	2	1	2	1
EE382.5	1	1	1		1	2	3	3	2	3	2	2	2	2	1
Avg. **EE382**	**2.00**	**2.00**	**2.00**	**3.00**	**1.80**	**2.33**	**2.40**	**2.67**	**2.33**	**2.75**	**2.20**	**2.40**	**2.00**	**2.60**	**2.00**

Mapping of COs with Knowledge Level (KL)	
EE382.1	K3: Applying
EE382.2	K3: Applying; K4 : Analysing
EE382.3	K4: Analysing; K5 : Evaluating
EE382.4	K6: Creating
EE382.5	K3: Applying

Project Evaluation Scheme (MID/END)

Items	**Project Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	EE382.1	EE382.2 EE382.3	EE382.3 EE382.4	EE382.3	EE382.2 EE382.3 EE382.4	EE382.5	EE382.2 EE382.3 EE382.5	EE382.3 EE382.4	EE382.5		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE352	**Industrial Drives & Control Lab**	**NIL**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives	
	This course describes the operation, application and control of variable speed drives.
	This course familiarizes the operation principles and design of drives for different transient conditions.
	This course introduces strong foundation to assess performance of different industrial drives.
	This course illustrates practical viabilities of different electrical drives towards energy efficiency.

Course Outcomes	CO's	Statement	Bloom's Taxonomy
	EE352.1	Able to understand the need of DC drives and their operations with power electronics converter for automations in industries.	Application Analysis
	EE352.2	Able to understand the need of AC drives and their operations with power electronics converter for automations in industries.	Comprehension Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE352.1	**3**	**3**	**3**	**2**	**3**	**1**	**1**					**3**	**3**	**2**	**2**
EE352.2	**3**	**3**	**3**	**2**	**3**	**1**	**1**					**3**	**3**	**2**	**2**
EE352	**3.00**	**3.00**	**3.00**	**2.00**	**3.00**	**1.00**	**1.00**					**3.00**	**3.00**	**2.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
1	**Study of Three phase fully controlled DC shunt motor drive.**	**02**	**CO1**
2	**Study of Dual converter fed DC motor drive.**	**02**	**CO1**
3	**Study of DC drive breaking operation for DC motor.**	**02**	**CO1**
4	**Study Ward Leonard's speed control method for a DC shunt motor.**	**02**	**CO1**
5	**DC motor speed control by Chopper drive.**	**02**	**CO1**
6	**Study of Retardation test of DC shunt motor.**	**02**	**CO1**
7	**Study of V/F method of speed control of induction motor.**	**02**	**CO2**
8	**Study of AC drive breaking operation for AC motor.**	**02**	**CO2**
9	**Study of Static Kramer drive.**	**02**	**CO2**
10	**Chopper-based speed control of slip ring induction motor.**	**02**	**CO2**
	Total Hours	**20**	

Essential Readings

1. Dubey G.K, "Fundamentals of Electrical Drives", Narosa Publishing House,2017
2. Pillai S.K., "A First Course on Electrical Drives", New Age International,2018

Supplementary Readings

3. De N.K., Sen P.K. "Electric Drives", Prentice Hall of India ,2018
4. Krishnan. R, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall of India ,2016
5. Ned Mohan et al, "Power Electronics: Converters, Applications, and Design", John Wiley & Sons. Inc. ,2019
6. Werner Leonhard, "Control of electrical drives", Springer,2015

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
EE354	**Switchgear and Protection Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- **To introduce electrical switchgear and protective relays**
- **To teach the computation of fault current in the electrical system.**
- **To develop an ability and skill to design various relay settings.**
- **To develop an ability and skill to design various electrical protection schemes.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE354.1	**Able to acquire knowledge about switchgears and identification of its application**	Knowledge Identification Application
EE354.2	**Able to acquire knowledge about protective relays and identification of application**	Knowledge Identification Application
EE354.3	**Able to compute the fault current and design of switchgears**	Compute, Design
EE354.4	**Able to design of protective relays**	Design
EE354.5	**Able to design of protection schemes for electrical equipments**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE354.1	**3**	**3**		**1**					**2**				**3**		**3**
EE354.2	**3**	**3**		**1**					**2**				**2**		**2**
EE354.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE354.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE354.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE354.6															
EE354	**2.4**	**2.6**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**2.4**	**3**	**2.4**

SYLLABUS

No.	Content	Hours	COs
1	Introduction to Laboratory Class	**02**	**All CO's**
2	Over-current and under-voltage protection schemes	**02**	
3	Over or under-frequency protection schemes	**02**	
4	Over or under-frequency protection schemes	**02**	
5	Power Reverse relay protection schemes	**02**	
6	Earth fault relay protection schemes	**02**	
7	Differential relay protection schemes	**02**	
8	Digital relay and design of distance protection schemes	**02**	
9	Study of MCB, Characteristics of HRC fuse, Visit report on protection schemes in substation	**02**	
10	Simulation exposure of switchgears and protection schemes	**02**	
11	Study of industrial circuit breaker and testing	**02**	
12	Make–up laboratory class	**02**	
Total Hours		**24**	

Essential Readings

1. P. M. Anderson, "Power System Protection", JW and IEEE Press, 1st Edition, 1998.
2. S. S. Rao, "Switchgear Protection and Power Systems", Khanna Publishers, 13th Edition, 1977.

Supplementary Readings

1. C. R. Mason, "Art & Science of Protective Relaying", John Wiley & Sons, 6th Edition, 1967.
2. T. S. M. Rao, "Solid State Protective Relaying", Tata McGraw-Hill, 2nd Edition, 2001.
3. Y. G. Paithankar and S.R. Bhide, "Fundamentals of Power Systems Protection", PHI, 2nd Edition, 2013.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE358	**Advanced Digital Signal Processing Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To learn coding and Simulink design in MATLAB for different applications**	Course Outcomes	EE258.1	Understand the basics operation of MATLAB	Knowledge Understand Apply Analyze
			EE258.2	Analysis the time domain and frequency domain signals.	Understand Apply Analyze
			EE258.3	Implement the concept of Fourier transforms.	Understand Apply Analyze
			EE258.4	Stability analysis of system using pole-zero diagrams and frequency response	Understand Apply Analyze
			EE258.5	Able to design system function in Simulink and Image analysis	Understand Apply Analyze Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE258.1	**3**			**3**	**2**				**1**	**1**		**2**	**2**	**3**	**2**
EE258.2	**3**	**2**	**1**						**2**	**2**		**2**	**2**	**3**	**2**
EE258.3	**2**	**2**	**2**		**2**				**1**	**1**		**1**	**2**	**3**	**2**
EE258.4	**2**	**1**	**2**	**2**	**1**				**1**	**1**		**2**	**1**	**3**	**2**
EE258.5	**1**	**2**	**3**	**2**	**1**				**1**	**1**		**2**	**2**	**3**	**2**
EE258	**2.2**	**1.4**	**1.6**	**1.6**	**1.2**				**1.2**	**1.2**		**1.8**	**2.40**	**3.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
1	**Familiarization to MATLAB** To learn variables, functions, vectors and matrices, arithmetic operators, and mathematical functions, to create signal, function, and use m-files, to study various MATLAB commands.	**02**	**CO1**
2	**Time Domain Analysis in MATLAB** To design linear convolution, circular convolution, auto-correlation and cross-correlation	**03**	
3	**Fourier Transform** Desing DFT and FFT algorithms	**03**	**CO2**
4	**Plot Pole-Zero Plot** Design and characteristic analysis of pole-zero system in s-domain and z-domain	**03**	**CO3**
5	**Frequency Response Analysis** Plot different kinds of frequency responses for different functions	**03**	
6	System **Design in SIMULINK** Realize the given function in the different structures in MATLAB Simulink	**03**	**CO4**
7	**Understanding 2-D and 3-D Plots for Image Processing** Plot 2-D and 3-D plots for Image analysis	**03**	
			CO5
	Total Hours	**20**	

Essential Readings

1. Amos Gilat, "MATLAB An introduction with Application" John Wiley & Sons inc. 2010
2. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications," Pearson Education.
3. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing," PHI.
4. Tarun Kumar Rawat, "Digital Signal Processing," Oxford University Press, 2015.

Supplementary Readings

1. Roberts M. J. and Govind Sharma, "Fundamental of Signals and Systems", Tata McGraw-Hill.

4th Year: Semester-7

B.Tech - Electrical and Electronics Engineering

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE411	**Wireless Power Transfer**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- **To introduce Basic Circuit Theory and Transformers.**
- **To teach the Fundamentals of Power Converters**
- **To develop ability and skill to design Compensation Configurations for Power Transfer**
- **To develop ability and skill on Applications and Technology Trends**

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	EE411.1	**Able to acquire knowledge about Basic Circuit Theory and Transformer principles and identification of its application**	Knowledge Identification Application
	EE411.2	**Able to acquire knowledge about Power Converter fundamentals and identification of application**	Knowledge Identification Application
	EE411.3	**Able to Design effective Compensation Configurations for optimized power transfer**	Design
	EE411.4	**Able to compute diverse Applications, considering various loading conditions**	Compute
	EE411.5	**Able to evaluate and adapt to current Technology Trends in power electronics and energy efficiency**	Evaluate Adapt

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE411.1	**3**	**3**	**3**	**2**	**1**	**1**		**1**				**1**	**3**	**2**	**2**
EE411.2	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**				**1**	**3**	**2**	**2**
EE411.3	**3**	**2**	**2**	**3**	**1**		**1**	**1**				**2**	**3**	**1**	**2**
EE411.4	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**2**				**1**	**3**	**3**	**2**
EE411.5	**3**	**2**	**2**	**1**	**1**		**3**					**1**	**3**	**1**	**3**
EE411	**3**	**2.6**	**2.6**	**2.4**	**1.8**	**1**	**2**	**1.25**				**1.2**	**3**	**1.8**	**2.2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction Basic Circuit Theory** Review of transformers, Leakage inductance, Circuit compensation principles, Low-order compensations; series and parallel compensations. Resonance and operating frequency. Efficiency equation.	**06**	**CO1**
II	**Power Converters Fundamentals** DC-DC converters. AC-DC converters and inverter. PWM and soft switching, principles. Basic topologies with transformers. Input, output and transfer, characteristics of power converters. Incorporation of leaky transformer. Control methods.	**10**	**CO2**
III	**Compensation Configurations** Types of compensation for inductor power transfer. Characteristics for various termination requirements. Design for load-independence output voltage and output current. Efficiency optimization.	**08**	**CO3**
IV	**Applications** Circuit requirements for various loading conditions. Characteristics of LED loads, resistors, and battery loads. Appropriate compensation design. Lighting systems, Battery charging profiles. Electric vehicle charging. Energy efficiency metric for charging.	**08**	**CO4**
V	**Technology Trends** Demand for safe power transfer and durable operation, Portable and smart devices, Mobile communication devices, IoT devices and systems, Sensors, Solid-state lighting development, and Battery technologies. Electric vehicle development. Renewable source integration trends. Future trends and demand for wireless power transfer.	**10**	**CO5**
Total Hours		**42**	

Essential Readings

1. C. T. Rim and C. Mi, Wireless Power Transfer for Electric Vehicles and Mobile Devices, New York: IEEE Press-Wiley, 2017.
2. J. I. Agbinya, Wireless Power Transfer, River Publishers, 2015.

Supplementary Readings

1. Z. Huang, S. C. Wong, and C. K. Tse, "Design of a single-stage inductivepower-transfer converter for efficient EV battery charging," IEEE Transactions on Vehicular Technology, vol. 66, no. 7, pp. 5808-5821, July 2017.
2. T. S. M. Rao, “Solid State Protective Relaying”, Tata McGraw-Hill, 2nd Edition, 2001. L. Xu, Q. Chen, X. Ren, S. C. Wong, and C. K. Tse, "Self-oscillating resonant converter with contactless power transfer and integrated current sensing transformer," IEEE Transactions on Power Electronics, vol. 32, no. 6, pp.4839-4851, June 2017.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE413	**Vehicular Technology**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To explain electric vehicle (EV) and hybrid electric vehicle (HEV), their architecture, technologies and fundamentals.		EE413.1	**Able to understand the various aspects of HEV/EV and their architecture, technologies and fundamentals.**	Understand
	To understand the design, component sizing of the power electronics converters, and various electric drives suitable for EV & HEV.		EE413.2	**Able to analyse the use of different power electronics converters and electrical machines in HEV/EV.**	Analyse
	To understand different energy storage technologies used for EV/HEV and their charging technologies.		EE413.3	**Able to understand the use of different energy storage systems for EV/HEV.**	Understand
			EE413.4	**Able to understand the control and management of vehicle charging stations.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE413.1	**3**	**3**	**3**	**2**	**1**	**3**	**3**		**1**		**1**	**1**	**3**	**3**	**2**
EE413.2	**3**	**3**	**3**	**2**	**1**	**1**			**1**		**1**	**1**	**3**	**3**	**3**
EE413.3	**3**	**3**	**2**	**3**	**3**	**3**	**3**		**1**		**1**	**1**	**3**	**3**	**3**
EE413.4	**3**	**3**	**3**	**3**	**3**	**2**	**1**		**1**		**1**	**1**	**3**	**3**	**3**
EE413	**3**	**3**	**2.75**	**2.5**	**2**	**2.25**	**1.75**		**1**		**1**	**1**	**3**	**3**	**2.75**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Electric & Hybrid Electric Vehicles:** History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, India's road-transport and importance of EVs in India, Impact of modern drive-trains on energy supplies, Principles of Hybrid Electric Drive-trains, Architectures, Basics of vehicle performance, Vehicle power source characterization, Transmission characteristics.	**10**	**CO1**
II	**Power Electronics in EV & HEVs:** Introduction to electric components, The drive Torque, Power, Speed and Energy, Fundamental of Drives and Control of EV Using DC motor, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, BLDC motor, Switched Reluctance Motor, Design and Sizing of Traction Motors.	**11**	**CO2**
III	**Storage Technologies:** Batteries for EV, Battery Characterization, Comparison of Different Energy Storage Technologies, Charging Control, Flywheel Energy Storage System, Fuel Cells and Hybrid Fuel Cell Energy Storage System and Battery Management System (BMS).	**10**	**CO3**
IV	**Charging Technologies:** Introduction to energy management strategies, Classification of different charging technology for EV charging station, Grid-to-Vehicle (G2V) system, V2X: Vehicle to Grid (V2G), Vehicle to Buildings (V2B), Vehicle to Home (V2H) operations, Energy management strategies used in hybrid and electric vehicle, Implementation issues of energy strategies.	**11**	**CO3** **CO4**
	Total Hours	**42**	

Essential Readings

1. Ali Emadi, Mehrdad Ehsani, John M. Miller 'Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles, 1st Edition, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Supplementary Readings

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2 nd Edition, CRC Press, 2003
2. P Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", 1 st Edition, John Wiley & Sons Ltd., 2011

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE415	**Electrical Machine Design**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	
To develop knowledge on principles of design of static and rotating machines.	
To understand the fundamental concepts of machine design.	
To know about methods to design main dimensions & cooling systems of transformers.	
To understand the design procedure of main dimensions of rotating machine.	

Course Outcomes		
CO's	**Statement**	**Bloom's Taxonomy**
EE415.1	Understand the basic principles of designing.	Knowledge Application
EE415.2	Acquire knowledge on design of machine windings	Comprehension Synthesis
EE415.3	Understand the sizing procedures of machines	Application Analysis
EE415.4	Design different parts of induction motor.	Comprehension Evaluation
EE415.5	Design different types of special machines such as SRM	Comprehension Synthesis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE415.1	**3**	**2**	**3**									**3**			**1**
EE415.2	**3**	**2**	**3**	**2**	**3**	**2**	**1**					**3**	**2**	**3**	**2**
EE415.3	**3**	**3**	**3**	**2**	**3**	**2**	**1**					**3**	**3**	**3**	**2**
EE415.4	**3**	**3**	**3**	**2**	**3**	**2**	**1**					**3**	**3**	**3**	**2**
EE415.5	**3**	**2**	**3**		**3**	**1**						**3**	**2**	**2**	**2**
EE415	**3.00**	**2.40**	**3.00**	**2.00**	**3.00**	**1.75**	**1.00**					**3.00**	**2.50**	**2.75**	**1.80**

SYLLABUS

No.	Content	Hours	COs
I	**Basic Design principles and Approaches** Electric Fields, Magnetic Fields, Review of Electromagnetic laws (Ohms Law, Amperes Law, Faraday's Laws, Thumb rule, Fleming's Left-hand and Right-hand rules, Lorentz Force Law), Magnetic Materials and Concepts of BH Curves, Magnetic Circuits with and without Air gaps, Multiple Winding Magnetic Circuits, Electromechanical Energy Conversion and Force in Electromagnetic Systems, Design and Analysis of the Electromagnetic System, Realization of Electrical Machines with the Principles of Electromagnets, Working Principles of the Rotating Machines, Design of Electrical Windings and MMF distribution, Thermal Issues, Limits and Heat Transfer Techniques, Cooling Methods and Design, Thermal Equivalent Circuits, Thermal Design of Electrical Machines	**06**	**CO1**
II	**Winding Design** DC Machine Windings, AC Machine Windings, Winding Design for Variable Speed Machines	**08**	**CO2**
III	**Design Factors and Sizing** Importance, Design Factors and Standards of the Electrical Machines, Electric and Magnetic Loadings, Sizing Equations with D2L (Volume) Product, Sizing Equations with D3L (Volume) Product-I, Sizing Equations with D3L (Volume) Product-II, Volume, Power Density.	**10**	**CO3**
IV	**Induction Motor Design** Induction Motor (IM) Design, Main dimensions, Stator Core Design of IM, Rotor Core Design of IM, Volume and Density of IM, IM Parameters Calculation like Leakage and Magnetizing Inductances-I, IM Parameters Calculation like Leakage and Magnetizing Inductances-II, Efficiency Calculations, Design of the Induction Motor for an Electric Vehicle Application	**10**	**CO4**
V	**Design of Special Machines** Design of Special Machines, Switched Reluctance Machine (SRM) Sizing Equations, Stator and Rotor Design of SRM, Machine Parameters of SRM, Efficiency Calculations of SRM	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. A course in Electrical Machine Design, A.K. Sawhney & A. Chakrabarty, Dhanpat rai & Co, 6th edition, 2010
2. Principle of Electrical Machine Design with computer programming, S.K. Sen, Oxford & IBH, 1st edition, 2006.

Supplementary Readings

3. Clayton A E & Hancock N N : The Performance and Design of Direct Current Machines ; CBS Publishers and Distributors, 1st edition, 2004
4. Norton, "Machine design", Pearson Education, 2nd edition, 2000.
5. Thomas A. Lipo, "Introduction to AC Machine Design", IEEE Press, John Wiley & Sons, 1st edition, 2017.
6. Krishnan, R., "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications", CRC Press, 1st edition, 2001.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE417	**Industrial Instrumentation**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To learn the usages of different sensors and their applications	Course Outcomes	EE417.1	Able to classify types of sensors and their application	Knowledge Understand
	To understand various types of sensor circuit design for industrial application		EE417.2	Able to design signal conditioning circuits for different sensors	Understand Evaluate Analyze Create
	To understand the concept of controlling circuit for sensors devices		EE417.3	Able to integrate controlling circuit to the sensor devices	Understand Evaluate Analyze Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE417.1	**3**	**3**		**1**		**1**			**1**			**1**	**3**		**3**
EE417.2	**3**	**3**		**1**		**1**			**1**			**1**	**2**		**2**
EE417.3	**2**	**3**	**3**	**1**	**2**	**1**						**1**	**2**	**3**	**2**
EE417	**2.66**	**3.0**	**3.0**	**1**	**2**	**1**			**1**			**1**	**2.33**	**3**	**2.33**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1:** Introduction to Industrial Instrumentation, Sensors and Transducers, Displacement and Strain Measurement, Load cell, Measurement of Forces, Torque and Angular Velocity Measurement, Pressure Measurement	**09**	**CO1, CO2**
II	**Module 2:** Temperature Sensors, Thermistor, Thermocouples, Pressure Measurement, Signal Conditioning Circuits, Piezoelectric Sensors, Ultrasonic Sensors, Nucleonic Instrumentation,	**09**	**CO1, CO2**
III	**Module 3:** Flow Measurement, Level Measurement, Flapper nozzle system, Signal conditioning circuits, Measurement of Magnetic Field, Optoelectronic Sensor, syncro	**08**	**CO1, CO2**
IV	**Module 4:** The measurement of Humidity, Moisture, pH and viscosity, Dissolved Oxygen Sensors, Smart Sensors, Gas Chromatography Pollution Measurement, Artificial intelligence, Signal Conditioning Integrated Circuits	**08**	**CO1, CO2**
V	**Module 5:** Introduction to Control System, Advanced Control Techniques, Overview of Process Controllers (SCADA, DCS, DAS, Data Loggers), Introduction to Programmable Logic Controller	**08**	**CO3**
	Total Hours	**42**	

Essential Readings

1. D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill, 2nd Edition, New Delhi, Reprint 2009
2. S. K. Singh, "Industrial Instrumentation & Control" 3rd Edition, Tata McGraw Hill, Reprint 2009
3. K. Krishnaswamy & S. Vijayachitra, "Industrial Instrumentation" New age International, Reprint 2008.
4.

Supplementary Readings

1. Ernest O. Doeblin, Dhanish. N. Manik, "Measurement Systems Application & Design", TMH, 5th Edition, 2004.
2. R. K. Jain, "Mechanical & Industrial Measurements", Khanna Publishers, 11th Edition, 2004.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE419	**Digital Control Systems**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce basic concepts of digital control systems**	Course Outcomes	EE419.1	**Able to acquire knowledge about basic concepts of digital control systems and identification of its application**	Knowledge Identification Application
	To teach the sampled data control systems design and stability analysis		EE419.2	**Able to acquire knowledge about sampled data control systems design and stability analysis**	Knowledge Design Analysis
	To develop ability and skill to deadbeat response design and discrete state space modeling		EE419.3	**Able to compute discrete state space modeling and design deadbeat response**	Compute Design
	To develop skill to state feedback design of discrete state space models		EE419.4	**Able to design of state feedback controller and observer design of discrete state space models**	Design
	To introduce the output feedback design and optimal control		EE419.5	**Able to design of discrete output feedback and optimal controls**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE419.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
EE419.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
EE419.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
EE419.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
EE419.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
EE419	**2.00**	**2.40**	**2.60**	**2.25**	**2.00**	**1.80**	**1.60**	**1.00**	**2.00**			**2.00**	**2.60**	**2.75**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to digital control** Introduction, Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction. Revisiting z-transform, Mapping of s-plane to z-plane, Pulse transfer function, Pulse transfer function of closed loop system, Sampled signal flow graph	**09**	**CO1**
II	**Stability analysis and Design of sampled data control systems** Jury stability test, Stability analysis using bi-linear transformation, Time response of discrete systems: Transient and steady state responses, Time response parameters of a prototype second order system. Root locus method, Controller design using root locus, Nyquist stability criteria, Bode plot, Lead compensator design, Lag compensator design, Lag-lead compensator design in frequency domain	**10**	**CO2**
III	**Deadbeat response design and Discrete state space model** Design of digital control systems with deadbeat response, Practical issues with deadbeat response design, Sampled data control systems with deadbeat response. Introduction to state variable model, Various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation	**08**	**CO3**
IV	**Controllability, observability, stability and State feedback design of discrete state space models** Controllability and observability, Stability, Lyapunov stability theorem, Pole placement by state feedback, Set point tracking controller, Full order observer, Reduced order observe	**08**	**CO4**
V	**Output feedback design and Optimal control** Output feedback design: Theory, Output feedback design: Examples, Introduction to optimal control, Basics of optimal control, Performance indices, Linear Quadratic Regulator (LQR) design	**07**	**CO5**
	Total Hours	**42**	

Essential Readings

1. B. C.Kuo, Digital Control Systems, Oxford University Press, 2nd Edition, Indian Edition, 2007.
2. K. Ogata, Discrete Time Control Systems, Prentice Hall, 2nd Edition, 1995.
3. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, 2nd Edition, 2003.

Supplementary Readings

1. G. F. Franklin, J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems, Pearson Education, Asia, 3rd Edition, 2000.
2. D. Subbaram Naidu, Optimal Control Systems, 1st Edition, CRC Press: Boca Raton, 2003.
3. K. J. Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design, Prentice Hall, 3rd Edition, 1997.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE421	**Modeling of Power Converters**	**EE421**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand the operation of different power electronic switches and their applications	Course Outcomes	EE421.1	**Understand the concepts of different type of Converters**	Knowledge Identification Application
	To know about on load operation of converters		EE421.2	**Design power electronics converters to convert the ac supply**	Knowledge Identification Application
	To understand control strategies of converter operation		EE421.3	**Design power electronics converters to convert fixed dc supply into variable dc**	Compute, Design
	To perform steady state analysis of different converters		EE421.4	**Design power electronics converters to convert dc supply into ac**	Design
			EE421.5	**Design power electronics converters to convert fixed ac supply into variable ac supply**	Design
			EE421.6		

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE421.1	**3**	**3**		**1**					**2**				**3**		**3**
EE421.2	**3**	**3**		**1**					**2**				**2**		**2**
EE421.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE421.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE421.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE421.6															
EE421	**2.40**	**2.60**	**3.00**	**1.00**	**2.00**	**2.00**	**3.00**		**2.00**			**1.00**	**2.40**	**3.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Overview of basic and advanced Power electronic converters;** various applications, basics of utility power conversion, isolated and non-isolated converter circuits, types of power converter models; Modeling and Control of Power Electronic Converters Reference Frame Transformation, Transfer Function modelling of Power Electronic Converters.	**06**	**CO1**
II	**Steady state converter analysis;** Steady state modeling of the power converters, DC transformer model, loss modelling; Dynamic modeling of the power converters, AC modeling of converters, state-space averaging, Transfer functions and frequency domain analysis, Extra Element Theorem.	**08**	**CO1**
III	**Pulse Width Modulation (PWM) control of power converters;** Voltage source and current source inverters, Feedback control design, voltage mode and current mode control, control of inverters and rectifiers; Analog and digital implementation of the controllers, Advanced analysis and control techniques applied to power electronics converters.	**06**	**CO1 CO2**
IV	**Design of Power Converters Components:** Design of magnetic components - design of transformer, design of inductor and current transformer - Selection of filter capacitors, Selection of ratings for devices, input filter design, Thermal design.	**08**	**CO2 CO3 CO4**
V	**Resonant Converters:** Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches. Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. Concept of Zero current switching, principle of operation, analysis of M-type and L-type Buck or boost Converters.	**08**	**CO4 CO5**
	Total Hours	**36**	

Essential Readings

1. Fundamentals of Power Electronics – Robert Erickson and Dragon Maksivimovic,
2. Springer Publications. Power Electronics–Issa Batarseh- John Wiely
3. Elements of Power Electronics - Philip T.Krein – Oxford University Press

Supplementary Readings

1. Power Electronics, L. Umanand, Tata Mc-Graw Hill
2. Switched Mode Power Conversion, Course Notes, CCE, IISc, 2004.
3. Issa Batarseh, 'Power Electronic Circuits', John Wiley, 2004.

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Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE423	**Adaptive Filtering**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To develop the basic theory of adaptive filtering, including Wiener filter, LMS, RLS		EE423.1	Able to understand adaptive concept in filter design	Knowledge Understand
	To learn the advanced strategies for optimization algorithm		EE423.2	Able to implement LMS algorithms in filter design	Understand Apply Analyze
			EE423.3	Able to implement RLS algorithms in filter design	Understand Apply Analyze
			EE423.4	Able to include decomposition and prediction concepts in the adaptive filtering	Apply Analyze Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE423.1	**3**	**3**		**1**		**1**			**1**			**1**	**3**		**3**
EE423.2	**3**	**3**		**1**		**1**			**1**			**1**	**2**		**2**
EE423.3	**2**	**3**	**3**	**1**	**2**	**1**						**1**	**2**	**3**	**2**
EE423.4	**3**	**3**		**1**		**1**			**1**			**1**	**2**		**2**
EE423	**2.75**	**3**	**3**	**1**	**2**	**1**			**1**			**1**	**2.25**	**3.0**	**2.25**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1:** Introduction to Adaptive Filters, Introduction to Stochastic Processes, Correlation Structure	**09**	**CO1**
II	**Module 2:** FIR Wiener Filter (Real) Steepest Descent Technique LMS Algorithm Convergence Analysis Convergence Analysis (Mean Square) Misadjustment and Excess MSE, Sign LMS Algorithm, Fast Implementation of Block LMS Algorithm, Fast Implementation of Block LMS Algorithm,	**09**	**CO2**
III	**Module 3:** Introduction to Recursive Least Squares, RLS Approach to Adaptive Filters, RLS Adaptive Lattice, RLS Lattice Recursions, RLS Lattice Recursions, RLS Lattice Algorithm, RLS Using QR Decomposition	**08**	**CO3**
IV	**Module 4:** Vector Space Treatment to Random Variables, Orthogonalization and Orthogonal Projection, Orthogonal Decomposition of Signal Subspaces, Introduction to Linear Prediction, Lattice Filter, Lattice Recursions, Lattice as Optimal Filter, Linear Prediction and Autoregressive Modeling, Gradient Adaptive Lattice	**08**	**CO4**
V	**Module 5:** Givens Rotation, Givens Rotation and QR Decomposition, Systolic Implementation, Systolic Implementation Singular Value Decomposition	**08**	**CO4**
	Total Hours	**42**	

Essential Readings

1. Tamal Bose, "Digital Signal and Image Processing" Wiley Publication, 2010
2. M. G. Larimore, C. R. Johnson and J. R. Treichler, "Theory and Design of Adaptive filters" 2001
3. B. F. Boroujeny, "Adaptive Filters: Theory and Applications" 2nd Edition, Wiley Publication, 2013

Supplementary Readings

1. S. D. Steams, "Fundamentals of Adaptive signal processing" 1985
2. M. G. Larimore, C. R. Johnson and J. R. Treichler, "Theory and Design of Adaptive filters" 2001

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Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE425	**Principles of Microwave Antennas**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		CO's	Statement	Bloom's Taxonomy
	To introduce fundamentals of waveguides and microwave radiation pattern			EE425.1	**Able to acquire knowledge about Waveguides and Microwave radiation pattern and identify their application**	Knowledge Identification Application
	To develop ability and skill about parameters of microwave wire and aperture antennas			EE425.2	**Able to acquire knowledge about microwave wire and aperture antennas and their application**	Knowledge Application
	To teach about the array of microwave radiating elements & reflector antenna			EE425.3	**Able to compute the array of Radiating elements and design the microwave Reflector antenna**	Compute Design
	To develop ability and skill for generalized microwave antenna analysis			EE425.4	**Able to design and analyze the generalized microwave antenna**	Design Analyze
	To introduce the concepts of modern microwave antenna			EE425.5	**Able to understand the concepts of modern microwave antenna**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE425.1	**3**	**3**	**2**	**1**					**2**				**3**	**2**	**3**
EE425.2	**3**	**3**	**2**	**1**					**2**				**2**	**2**	**2**
EE425.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**		**1**			**2**	**2**	**3**	**2**
EE425.4	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE425.5	**2**	**2**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE425	**2.40**	**2.60**	**2.60**	**1.20**	**2.00**	**2.00**	**2.67**		**1.80**			**1.33**	**2.60**	**2.60**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Waveguides & Microwave Radiation Fundamentals** RF and Microwave Transmission Lines: Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Concept of Scalar and Vector Potentials, Radiation from a Current Element (Hertzian Dipole), Specific Properties of Radiated Fields from a Current Element, General Properties of Radiated Fields from an Antenna, Farfield and Radiation Pattern of an Antenna.	**09**	**CO1**
II	**Antenna Parameters & Wire and Aperture Antennas** Directivity and Gain of an Antenna, Idea of Efficiency, Beamwidth, Polarisation and Bandwidth, Polarization, Impedance, Effective Aperture of an Antenna. Friss Transmission Equation and Antenna Temperature, Dipole and Monopole Antenna, BALUN, Loop Antenna. Aperture Antennas: Folded Dipole Antenna, Introduction to Antenna Array, Antenna Array Theory, Broadside Uniform Linear Array, Endfire Linear Uniform Array	**10**	**CO2**
III	**Array of Radiating Elements & Reflector Antenna** Array of Radiating Elements: Parasitic Array and Log Periodic Antenna, Analysis Procedures of Aperture Antennas, Horn Antenna. Reflector Antenna: Paraboloid Reflector Antenna, Dual Reflector Antenna	**07**	**CO3**
IV	**Generalized Antenna Analysis** Generalised Analysis of Antenna, Solution of Wave Equation for Electric and Magnetic Current Densities, Farfield Evaluation of Spherical Wave Radiation by Generalised Antenna, Slot Antenna, Open Ended Waveguide Antenna and Microstrip Antenna	**08**	**CO4**
V	**Selected Advanced Topics of Modern Antenna** Numerical Evaluation of Wire Antenna Currents, Solution of Integral Equation by Moment Method, Array Pattern Synthesis, Ultra-Wideband Antennas, Antenna Measurements	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. R. E. Collins, Foundations for Microwave Engineering, McGraw Hill, 2nd Edition, 1992.
2. David M Pozar, Microwave Engineering-, John Wiley India Pvt Ltd., 3rd Edition, 2008.
3. Sushrut Das, Microwave Engineering-, Oxford Higher Education, 2nd Edition, 2015

Supplementary Readings

1. Harish and Sachidananda, Antennas and Wave Propagation, Oxford University Press, 2007
2. Microwave Devices and circuits- Liao, Pearson Education, 3rd Edition, 1996

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE427	**Wireless and Cellular Communications**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce fundamentals of wireless and cellular communications/ networks**	Course Outcomes	EE427.1	**Able to acquire knowledge about the communication theory both physical and networking associated with GSM, CDMA & LTE 4G systems**	Knowledge Identification Application
	To teach the design requirement of different cellular system/networks		EE427.2	**Able to explain concepts of propagation mechanisms like Reflection, Diffraction, Scattering in wireless channels**	Explain
	To develop ability and skill about antenna fading and Wide Sense Stationary Uncorrelated Scattering in antenna network		EE427.3	**Able to compute and develop a scheme for call set up, call progress handling and call tear down in a GSM cellular network**	Compute, Develop
	To develop skill about antenna selection diversity and statistical characterization of WCDMA antenna		EE427.4	**Able to compute and develop a scheme for call set up, call progress handling and call tear down in a WCDMA cellular network**	Compute, Develop
	To develop skill about LTE 4G network architecture and modulation		EE427.5	**Able to understand the basic operations of air interface in the LTE 4G system**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE427.1	**3**	**3**	**2**	**1**					**2**				**3**	**2**	**3**
EE427.2	**3**	**3**	**2**	**1**					**2**				**2**	**2**	**2**
EE427.3	**2**	**3**	**3**	**1**	**2**		**2**		**1**			**2**	**2**	**3**	**2**
EE427.4	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE427.5	**2**	**2**	**3**	**1**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE427	**2.40**	**2.60**	**2.60**	**1.20**	**2.00**	**2.00**	**2.67**		**1.80**			**1.33**	**2.60**	**2.60**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	Overview of Cellular Systems, 5G and other Wireless Technologies. Wireless Propagation and Cellular Concepts: Basic Cellular Terminology, Introduction to Antennas and Propagation Models, Link budget, Fading margin, Outage, Cellular Concept	**06**	**CO1**
II	Cellular System Design, Capacity, Handoff, and Outage: Cellular Geometry & System Design, Cellular System Capacity, Trunking, Handoff & Mobility, Classification of Signal Variation, Shadowing, Outage. Multipath Fading Environment: Rayleigh Fading and Statistical Characterization, Properties of Rayleigh Distribution, BER in Fading, Narrowband vs Wideband Channels, Characterization of Multipath Fading Channels, Choice of Modulation	**07**	**CO2**
III	BER Performance in Fading Channels: Coherent versus Differential Detection, BER in Fading, Ricean Fading, Ricean and Nakagami Fading, Moment Generating Function (MGF). Wide Sense Stationary Uncorrelated Scattering (WSSUS) Channel Model: Wireless Channel Capacity, Coherence Time, Doppler Spectrum, Temporal Characteristics of Fading Channels, WSSUS Characterization of Time Dispersive Fading Channels, WSSUS Classification of Fading Channels	**07**	**CO3**
IV	Introduction to Diversity, Antenna selection diversity, Statistical Characterization of Antenna Diversity, Optimal Diversity Combining. Fading Channels - Diversity and Capacity: BER in fading, Equal Gain Combining, Array Gain, Diversity Gain, Alamouti Scheme, Channel Capacity, Capacity of fading Channels, Capacity with Outage, Channel State Information	**07**	**CO4**
V	Optimum Power Allocation - Water filling, Introduction to Direct Sequence Spread Spectrum Communications. Properties of Spreading Sequences, Introduction to CDMA, Features of CDMA2000 and WCDMA, CDMA Receiver: Rake Receiver for multipath channels, Multiuser environment, CDMA system Capacity, CDMA Multiuser Detectors	**07**	**CO5**
VI	Key Enablers for LTE 4G: OFDM, SC-FDE, SC-FDMA, Channel Dependant Multiuser Resource Scheduling, Multi-Antenna Techniques, Flat IP Architecture, LTE Network Architecture. Multi-Carrier Modulation: Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing and Frequency Synchronization, Peak to Average Ration, SC- Frequency Domain Equalization, Computational Complexity Advantage of OFDM and SC-FDE.	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Gary Mullet, "Introduction to Wireless Telecommunications Systems and Networks", 1st Edition, Cengage Learning India Pvt Ltd., 2006.
2. Theodore Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Prentice Hall, 2002.

Supplementary Readings

1. Harri Holma and Antti Toskala, "LTE for UMTS Evolution to LTE-Advanced", 2nd Edition, John Wiley & Sons Ltd., 2011.
2. Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, "Fundamentals of LTE", Pearson Education, 2010.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE429	**Advanced Control System Design**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the continuous time linear and nonlinear systems in state space framework.**	Course Outcomes	EE429.1	**Able to acquire knowledge about continuous time systems and nonlinear systems in state space and their applications.**	Knowledge, Application
	To model and discuss different dynamic systems in the state-space framework.		EE429.2	**Able to obtain the mathematical models of linear and nonlinear control systems in the state-space form.**	Obtain, Application
	To discuss the performance and stability of continuous and nonlinear dynamic systems.		EE429.3	**Able to compute and analyse the performance and stability of continuous time dynamic systems.**	Compute, Analyze
	To teach the linear and nonlinear analysis and synthesis techniques.		EE429.4	**Able to apply linear and nonlinear analysis and synthesis techniques**	Apply
	To discuss different controllers and observers design using analytical and graphical techniques.		EE429.5	**Able to design different types of controllers and observer for linear and nonlinear systems.**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE429.1	**3**	**3**	**2**	**1**	**2**	**2**			**2**			**2**	**3**	**2**	**2**
EE429.2	**3**	**3**	**2**	**1**	**1**	**2**			**2**			**1**	**2**	**2**	**2**
EE429.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**					**2**	**2**	**3**	**3**
EE429.4	**3**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**3**
EE429.5	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE429	**2.60**	**2.60**	**2.60**	**1.60**	**1.80**	**2.00**	**2.67**		**2.00**			**1.60**	**2.40**	**2.60**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Continuous Time Systems in State-Space** Introduction of State-Space, modelling of dynamic systems, State Diagram, Linear Transformation of state variables, State-Space representation in Canonical forms: Diagonal, Controllable, Observable, & Jordan Diagonal canonical form. Conversions between State Space and Transfer Function models. State transition matrix, Properties, Computation of State Transition Matrix by Laplace transform approach, Solution of Homogeneous and Non-homogeneous State equation of continuous time invariant systems.	**10**	**CO1** **CO2**
II	**Pole Placement Controller/Observer Design of Linear Systems** Concepts of Controllability, Observability, Stabilizability & Detectability. Design of state variable feedback, Regulator design via pole placement method, Determination of full state feedback gain using Direct-comparison method, Controllable canonical form method and Ackermann's formula. State observers, Design of Full order state observers, Reduced order state observers.	**09**	**CO1** **CO3** **CO5**
III	**Nonlinear Systems Analysis** **Phase-plane analysis:** Singular points, Phase portrait, Limit Cycle, Qualitative behaviour at near equilibrium points, Jacobian linearization, Construction of phase trajectories-Isocline method, Delta method, Stability of nonlinear systems by phase-plane. **Describing Function Analysis:** Common physical nonlinearities, Jump resonance, Describing Function of typical nonlinearities, Existence of limit cycles, Stability analysis by describing function method. **Lyapunov's Stability Analysis:** Stability definitions-local stability, Asymptotic stability, Asymptotic stability in large, Instability, Lyapunov's stability criterion, Lyapunov function, Sign definiteness of scalar functions, Sylvester's criterion, Lyapunov's Direct method for linear systems, Construction of Lyapunov function, Asymptotic stability of nonlinear systems.	**12**	**CO1** **CO3** **CO4**
IV	**Nonlinear Control Synthesis** Dynamic Inversion-I, Dynamic Inversion-II, Neuro-Adaptive Design-I, Neuro-Adaptive Design-II	**06**	**CO4**
V	**Nonlinear Observer & Kalman Filter Design** Integrator Back-Stepping, Linear Quadratic Observer, An Overview of Kalman Filter Theory	**05**	**CO5**
	Total Hours	**42**	

Essential Readings

1. N. S. Nise: Control Systems Engineering, 4th Edition, Wiley, 2004.
2. K. Ogata, "Modern Control Engineering", PHI, 5th Edition, 2010.
3. H. J. Marquez, "Nonlinear Control Systems: Analysis and Design", John Wiley Interscience, 2nd Edition, 2003.

Supplementary Readings

1. J. E. Slotine and W. Li, "Applied nonlinear control", Prentice Hall, 1st Edition, 1991.
2. K. Ogata, "Discrete time Control Systems", Pearson Education India, 2nd Edition, 2015.
3. H. K. Khalil, "Nonlinear Systems", Pearson Education India, 3rd Edition, 2014.

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Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE431	**Microgrids & Control Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
To understand the modelling and implementation of microgrids.		EE431.1	**Able to understand about fundamental concepts of microgrid and its components.**	Understand
To understand operation and control of AC/DC microgrid systems.		EE431.2	**Able to understand the application of power electronics in microgrids.**	Understand Application
		EE431.3	**Able to develop and analyse the model of AC and DC microgrids.**	Develop Analyse
		EE431.4	**Able to understand the operation and control of microgrids and analyse the stability of a microgrid.**	Understand Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE431.1	**3**	**3**	**1**	**1**	**1**	**1**	**3**	**2**				**2**	**3**		**1**
EE431.2	**3**	**3**	**3**	**3**	**2**		**3**	**1**				**1**	**3**		**1**
EE431.3	**3**	**3**	**3**	**3**	**2**		**3**	**1**				**1**	**3**		**1**
EE431.4	**3**	**3**	**3**	**3**	**2**		**3**	**1**				**1**	**3**		**1**
EE431	**3**	**3**	**2.5**	**2.5**	**1.75**	**0.25**	**3**	**1.25**				**1.25**	**3**		**1**

SYLLABUS

No.	Content	Hours	COs
I	Overview of Microgrids, Concept of Microgrids, Microgrid and distributed generation, Microgrid vs Conventional Power System, AC and DC Microgrid with Distributed Energy Resources.	06	CO1
II	Power Electronics for Microgrid, Power Electronic Converters in Microgrid Applications, Power Electronic Converters in Microgrid Applications (Power Electronic for Interfacing), Power Electronic Converters in Microgrid Applications (Converter Modulation Techniques).	10	CO2
III	Modeling of converters in microgrid power system (AC/DC and DC/AC Converters Modeling), Modeling of Power Converters in Microgrid Power System (DC/DC Converter Modeling and Control), Modeling of Wind Energy System and Photovoltaic System, Modeling of Energy Storage System.	10	CO3
IV	Microgrid Dynamics and Modeling, Microgrid Operation Modes and Standards, Microgrid Control Architectures, Intelligent Microgrid Operation and Control, Energy Management in Microgrid System, DC Microgrid System Architecture and AC Interface, DC Microgrid Dynamics and Modeling, Control of DC Microgrid System, Applications of DC Microgrids, Stability Analysis of DC Microgrid, DC Microgrid stabilization strategies, General Summary of DC Microgrids.	16	CO4
	Total Hours	**42**	

Essential Readings

1. Fusheng Li, Ruisheng Li, Fengquan Zhou, Microgrid Technology and Engineering Application, Elsevier, 2015.
2. S. Chowdhury, P. Crossley, Microgrids and Active Distribution Networks, Institution of Engineering and Technology, 2009.
3. Hassan Bevrani, BrunoFrançois, Toshifumi Ise, Microgrid Dynamics and Control John Wiley Sons, 2017.
4. Nikos Hatziargyriou, Microgrids Architectures and Control John Wiley Sons, 2014.

Supplementary Readings

1. Gevork B. Gharehpetian, S. Mohammad Mousavi Agah, Distributed Generation Systems: Design, Operation and Grid Integration, Butterworth Heinemann, 2017.
2. Manuela Sechilariu, Fabrice Locment, Urban DC Microgrid: Intelligent Control and Power Flow Optimization, Butterworth-Heinemann, 2016.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE433	**Advanced Power Electronics**	**EE433**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the operation of different power electronic switches and their applications		EE433.1	**Understand the operation of different power electronics switches and their usage for different applications**	Knowledge Identification Application
	To know about on load operation of converters		EE433.2	**Design power electronics converters to convert the ac supply into dc**	Knowledge Identification Application
	To understand control strategies of converter operation		EE433.3	**Design power electronics converters to convert fixed dc supply into variable dc**	Compute, Design
	To perform steady state analysis of different converters		EE433.4	**Design power electronics converters to convert dc supply into ac**	Design
			EE433.5	**Design power electronics converters to convert fixed ac supply into variable ac supply**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE433.1	**3**	**3**		**1**					**2**				**3**		**3**
EE433.2	**3**	**3**		**1**					**2**				**2**		**2**
EE433.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE433.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE433.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE433.6															
EE433	**2.40**	**2.60**	**3.00**	**1.00**	**2.00**	**2.00**	**3.00**		**2.00**			**1.00**	**2.40**	**3.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**SWITCHED MODE POWER SUPPLIES (SMPS)** DC Power supplies and Classification; Switched mode dc power supplies - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.	**06**	**CO1**
II	**AC-DC CONVERTERS** Switched Mode Rectifier - Operation of Single/Three Phase bilateral Bridges in Rectifier Mode .Control Principles. Control of the DC Side Voltage. Voltage Control Loop. The inner Current Control Loop. Single phase and three phase boost type APFC and control, three phase utility inter-phases and control	**05**	**CO1**
III	**DC-AC CONVERTERS** PWM Inverters (Single-Phase & Three-Phase): Principle of operation – performance parameters –single phase bridge inverter – single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance; Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes.	**09**	**CO1** **CO2**
IV	**SOFT-SWITCHING POWER CONVERTERS** Introduction to Resonant Converters. Classification of Resonant Converters. Basic Resonant Circuit Concepts. Load Resonant Converter. Resonant Switch Converter. ZVS, ZCS, quasi resonance operation; Performance comparison hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter.; Resonant DC power supplies.	**08**	**CO2** **CO3** **CO4**
V	**Cyclo-converter / AC-AC Converter** Principle of AC Voltage Controllers – Integral Cycle Control and Phase Control, Types of AC voltage controllers, Analysis of 1-phase & 3-phase voltage controllers with R and R-L load. Principle of operation of cyclo-converters, circulating and non circulating mode of operation, single phase to single phase step up and step down Cyclo-converters, three phase to single phase Cyclo-converters, three phase to three phase Cyclo-Converter .	**08**	**CO4** **CO5**
	Total Hours	**36**	

Essential Readings

1. M H Rashid, "Power Electronics, Circuits, Devices, Application"
2. B K Bose, "Modern Power Electronics and AC Drives".
3. Ned Mohan, T M Undeland, "Power Electronics Converters, Applications and Design", John Willey.

Supplementary Readings

1. Agarwal J P, "Power Electronic Systems: Theory and Design", Addison Wesley Longman Ptc. Ltd.
2. Singh M D, Khanchandani K B, "Power Electronics", Tata McGraw-Hill publishing Co. Ltd.
3. L Umanand, "Power Electronics Essentials and Applications", Wiley India.

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Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE435	**Intelligent Systems and Control**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes		CO's	Statement	Bloom's Taxonomy
	To introduce the fundamentals of Intelligent Systems and Control in state space framework.			EE435.1	**Able to acquire knowledge about Intelligent Systems and Control and their applications.**	Knowledge Application
	To discuss Neural Networks and Algorithms for Intelligent systems.			EE435.2	**Able to acquire knowledge about Neural Networks and Algorithms for Intelligent systems**	Knowledge
	To develop ability and skill about Neural Networks control techniques.			EE435.3	**Able to design and analyse the performance of Neural Networks control techniques**	Design Analyze
	To discuss Fuzzy Logic & Algorithms for Intelligent systems.			EE435.4	**Able to acquire knowledge about Fuzzy Logic and Algorithms for Intelligent systems**	Knowledge
	To develop ability and skill about Fuzzy control techniques.			EE435.5	**Able to apply different Fuzzy control techniques.**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE435.1	**3**	**3**	**2**	**1**	**2**	**2**			**2**			**2**	**3**	**2**	**2**
EE435.2	**3**	**3**	**2**	**1**	**1**	**2**			**2**			**1**	**2**	**2**	**2**
EE435.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**					**2**	**2**	**3**	**3**
EE435.4	**3**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**3**
EE435.5	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE435	**2.6**	**2.6**	**2.6**	**1.6**	**1.8**	**2**	**2.67**		**2**			**1.6**	**2.4**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Intelligent Systems and Control** Motivation-Intelligent Systems and Control, Nonlinearity, Introduction of State-Space, Modelling of dynamic systems, State transition matrix, Properties, Computation of State Transition Matrix by Laplace transform approach, Solution of Homogeneous and Non-homogeneous State equation of continuous time invariant systems.	**07**	**CO1**
II	**Neural Networks & Algorithms** Linear Neural networks, Multi layered Neural Networks, Back Propagation Algorithm revisited, Nonlinear System Analysis, Radial Basis Function Networks, Adaptive Learning rate, Weight update rules, Recurrent networks Back propagation through time, Recurrent networks Real time recurrent learning, Self-organizing Map - Multidimensional networks	**09**	**CO1** **CO2**
III	**Neural Networks Control Techniques** Neural Control: A review, Network inversion and control, Neural Model of a Robot manipulator, Indirect Adaptive Control of a Robot manipulator, Adaptive neural control for Affine Systems with SISO and MIMO, Visual Motor Coordination with KSOM and quantum clustering, Direct Adaptive control of Manipulators, NN based back stepping control	**09**	**CO3**
IV	**Fuzzy Logic & Algorithms** Fuzzy sets: A Primer, Fuzzy Relations, Fuzzy Rule base and Approximate Reasoning, Introduction to Fuzzy Logic Control, Illustrative examples	**09**	**CO1** **CO4**
V	**Fuzzy Control** Fuzzy Control - a Review, Mamdani type flc and parameter optimization, Fuzzy Control of a pH reactor, Fuzzy Lyapunov controller - Computing with words, Controller Design for a T-S Fuzzy model, Linear controllers using T-S fuzzy model	**08**	**CO5**
Total Hours		**42**	

Essential Readings

1. L. Behera and I. Kar, Intelligent Systems and Control: Principles and Applications, Oxford: New Delhi, India, 2009.
2. K. M. Passino, Biomimicry for Optimization, Control, and Automation, Springer-Verlag: London, UK, 2005.
3. N. Siddique, Intelligent Control: A Hybrid Approach Based on Fuzzy Logic, Neural Networks and Genetic Algorithms, Springer: Switzerland, 2014

Supplementary Readings

1. Y. Narayana, Artificial Neural Networks, Prentice Hall of India, 1999.
2. J. T. Ross, Fuzzy Logic with Engineering Applications, John Wiley, 2nd Edition, 2004.
3. J. Liu, Intelligent Control Design and MATLAB Simulation, Springer: Beijing, 2018

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Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE437	**Optimal Control System**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the optimal control system and its performance index**	Course Outcomes	EE437.1	**Able to acquire knowledge about optimal control system and its applications.**	Knowledge Application
	To discuss linear quadratic control systems and regulator problems.		EE437.2	**Able to design the optimum linear quadratic control systems for regulator problems.**	Design
	To discuss the solving approach of matrix differential Riccati equation.		EE437.3	**Able to compute the solution of matrix differential Riccati equation.**	Compute
	To develop the skill about the dynamic programming optimization approach		EE437.4	**Able to apply the dynamic programming optimization approach**	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE437.1	**3**	**3**	**2**	**1**	**2**	**2**			**2**			**2**	**3**	**2**	**2**
EE437.2	**3**	**3**	**2**	**1**	**1**	**2**			**2**			**1**	**2**	**2**	**2**
EE437.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**					**2**	**2**	**3**	**3**
EE437.4	**3**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**3**
EE437.5	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE437	**2.60**	**2.60**	**2.60**	**1.60**	**1.80**	**2.00**	**2.67**		**2.00**			**1.60**	**2.40**	**2.60**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction and Performance Index** Basic Concept of calculus of variation, The basic variational problem, Fixed end point problem, Free end point problem, Optimum of a function with conditions, Optimum of Functions with Conditions (Lagrange Multiplier Method)	**10**	**CO1**
II	**Optimum of a functional with conditions** Variational Approach to Optimal Control Systems, Linear Quadratic Optimal Control Systems, Optimal Value of Performance Index for Linear Quadratic Optimal Control Systems, Infinite Horizon Regulator Problems	**11**	**CO2**
III	**Solution of Matrix Differential Riccati Equation** Analytical Solution of Matrix Differential Riccati Equation: State Transition Matrix Approach, Similarity Transformation Approach, Frequency Domain Interpretation of LQR (Linear Time Invariant System), LQR with a Specified Degree of Stability, Inverse Matrix Riccati Equation, Linear Quadratic Tracking System	**10**	**CO3**
IV	**Optimal Control Using Dynamic Programming** Introduction to Dynamic Programming, The Hamilton-Jacobi-Bellman (HJB) Equation, LQR System Using HJB Equation, Time Optimal Control System with Constrained Input	**11**	**CO4**
	Total Hours	**42**	

Essential Readings

1. D. Subbaram Naidu, Optimal Control Systems, CRC Press: Boca Raton, 2003.
2. D.E. Kirk, Optimal Control Theory: An Introduction, Prentice Hall, Englewood Cliffs, NJ, 1970.
3. F. L. Lewis, Optimal Control, John Wiley & Sons Inc., New York, 1986.

Supplementary Readings

1. D. Bertsekas, Nonlinear Programming. Nashua, NH: Athena Scientific, 1999.
2. A. Bryson, Dynamic Optimization. Upper Saddle River, NJ: Pearson Education, 1998.
3. A. P. Sage, C. C. White, Optimum Systems Control, Prentice Hall, Englewood Cliffs, N.J., 1977.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE441	**Smart Grid Technology**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To teach the basic concepts, components, and architecture of smart grid.		EE441.1	Able to understand the features and architecture of Smart Grid.	Understand
	To familiarize the students with the new technologies for grid-interfaced DG system with storage.		EE441.2	Able to analyse the role of automation in transmission and distribution.	Analyse
	To explain the communication technologies and the cyber-security threats in Smart Grid.		EE441.3	Able to understand and analyse the operation of DG, EVs and storage technologies.	Understand Analyse
	To teach the fundamental requirements for planning ancillary services in Smart Grid.		EE441.4	Able to understand the communication technologies and cyber-security in Smart Grid.	Understand
			EE441.5	Able to analyse the planning, operation, and control of Smart Electric Grid.	Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE441.1	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**				**1**	**3**		
EE441.2	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**				**1**	**3**		**1**
EE441.3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**		**1**		**1**	**3**		**2**
EE441.4	**3**	**3**	**3**	**3**	**3**	**1**		**1**				**1**	**3**		**3**
EE441.5	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**1**		**2**		**1**	**3**		**3**
EE441	**3**	**3**	**2.6**	**2.4**	**2.6**	**1.2**	**1.2**	**1**		**0.6**		**1**	**3**		**1.8**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Smart Grid:** Introduction, Definition of smart grid, Concept of smart grid structure, Conventional grid Vs. Smart grid, Opportunities & Barriers of Smart Grid, Enablers of smart grid, General View of the Smart Grid Market Drivers, Stakeholder Roles and Function, Measures, Representative Architecture, Functions of Smart Grid Components, Key Challenges for Smart Grid.	**08**	**CO1**
II	**Smart Grid Architecture:** Components and Architecture of Smart Grid, Review of the proposed architectures for Smart Grid, Advanced metering infrastructure, The fundamental components of Smart Grid designs –Transmission Automation –Distribution Automation – Renewable Integration, P2P Energy trading.	**08**	**CO1** **CO2**
III	**Distribution Generation Technologies:** Basic Introduction of DGs and DER technologies, Microgrid Design and Components, Energy management, Storage Technologies, Electric Vehicles (EV), EV Chargers, Vehicle-to-grid (V2G), Concept of V2X, Environmental impact and Climate Change, Economic Issues.	**08**	**CO3**
IV	**Communication Technologies and Smart Grid:** Introduction to Communication Technology, Two-way digital communications paradigm, Synchro-Phasor Measurement Units (PMUs), Wide Area Measurement Systems (WAMS), Introduction to Internet of things (IOT) in Smart Grid, Cyber Security for Smart Grid.	**09**	**CO4**
V	**Smart Grid Planning:** Planning aspects of Smart Grid, Operation and control of Smart Grid, Demand side management, Demand response, Energy management operation, Transactive energy framework.	**09**	**CO5**
	Total Hours	**42**	

Essential Readings

1. J. Ekanayake, N. Jenkins, K. Liyanage, J.Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, 1st Edition, 2012.
2. Stuart Borlase, Smart Grids, "Infrastructure, Technology and Solutions", CRC Press, 1st edition, 2012.
3. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE, 3rd Edition, 2019.

Supplementary Readings

1. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer Edition, 2nd Edition, 2017.
2. J. A. Momoh, "Smart Grid: Fundamentals of Design and Analysis," Wiley-IEEE Press, 1st Edition, March 2012.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE443	**Renewable and Distributed Generation**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- **To impart in-depth knowledge on the environmental impact of renewable energy sources.**
- **To introduce the basic concepts of solar PV, wind energy, and other renewable energy sources.**
- **To deliver an in-depth understanding of different energy sources and their modeling.**
- **To explain the concept of a distributed generation system with a suitable control scheme for standalone and grid-tied applications.**

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	EE443.1	**Able to acquire knowledge of different types of renewable energy sources and distributed generations.**	Knowledge
	EE443.2	**Able to apply knowledge of solar PV systems, their operating principle, and solar thermal systems in practical applications.**	Knowledge
	EE443.3	**Able to understand and analyse wind energy conversion systems with their control scheme for effective power generation.**	Understand, Analyse
	EE443.4	**Able to gain an understanding of the biomass, tide, wave, hydel, and hydrogen-based power generation systems.**	Understand
	EE443.5	**Able to learn the concept of distributed generations and develop hybrid renewable energy generation systems.**	Develop

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE443.1	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**				**1**	**3**	**1**	**1**
EE443.2	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**				**1**	**3**	**1**	**2**
EE443.3	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**				**1**	**3**	**1**	**2**
EE443.4	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**				**1**	**3**	**1**	**2**
EE443.5	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**1**				**1**	**3**	**3**	**3**
EE443	**3**	**3**	**3**	**2**	**2.8**	**1.8**	**2.8**	**1.2**				**1**	**3**	**1.4**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Energy Resources** Energy sources on earth – World energy resources – Indian energy scenario – Global energy problems and role of renewable energy –renewable energy resources and their importance – Environmental aspects of energy utilization.	**03**	**CO1**
II	**Solar Energy** Availability of solar energy, Present and new technological developments in photovoltaic, estimation of solar irradiance, solar cell energy conversion, efficiency, characteristics, effect of variation of solar insolation and temperature, losses, components of solar energy systems, solar-thermal system applications to power generation, and heating.	**07**	**CO2**
III	**Wind Energy** Wind resource assessment, power conversion technologies, wind power estimation techniques, principles of aerodynamics of wind turbine blade, wind mechanics, power content, class of wind turbines, various aspects of wind turbine design, wind turbine generators, and aspects of the location of wind farms.	**10**	**CO3**
IV	**Bio-Mass, Bio-Gas, Tide, and Wave Energies** Basic concepts and principles of operation – Operating principle of biomass – Combustion and fermentation, anaerobic digester, Tidal power generation – Wave energy utilization.	**07**	**CO4**
V	**Hydrogen Energy** Hydrogen as a renewable energy source & sources of hydrogen – Fuel cells – principle of operation – classification and types of fuel cells – Application in Electric Vehicle– Limitations and future prospect.	**05**	**CO4**
VI	**Hydel Energy** Water power estimates, use of hydrographs, hydraulic turbine, Classification of hydel plants, concept of micro hydel, MHP plants: components, design and layout, turbines, efficiency.	**04**	**CO4**
VII	**Distributed Generation Systems** Benefits and limitations; classification of small generating systems, electric equivalent circuits of fuel cells, solar cells, micro-turbines, reciprocating engines, wind turbines, and gas turbines, effects of renewable energy into the grid, supply guarantee, power quality, stability, intentional and unintentional islanding, power converter topologies for grid interconnection, inverter modeling, control of grid-interactive power converters, synchronization and phase locking techniques, current control, and recent trends in DG interconnection.	**06**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Andrews J, Jelley N, "Energy Science", Oxford University Press, 2010
2. Fang Lin Luo, Hong Ye, "Renewable Energy Systems: Advanced Conversion Technologies and Applications", CRC Press, Taylor & Francis Group.
3. H Lee Willis, Walter G Scott "Distributed Power Generation, Planning & Evaluation", CRC Press Taylor & Francis Group.
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, "Grid Converters for Photovoltaic and Wind Power Systems", John Wiley & Sons.
5. B H Khan, "Non-Conventional Energy Resources", Tata McGraw-Hill Education.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE445	**Special Electrical Machines**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	
	This course provides thorough knowledge in the emerging field of special electrical machines.
	This course explains principle of operation, design aspects and control of different types of special electrical machines.
	This course generates awareness about industrial applications and possibility of performing projects on special electrical applications.

Course Outcomes	CO's	Statement	Bloom's Taxonomy
	EE445.1	Able to know about construction features and method of operation of stepper motor.	Knowledge Application
	EE445.2	Able to understand the fundamentals, construction details and classification of switched reluctance motors.	Comprehension Synthesis
	EE445.3	Able to analyse and apply the fundamentals of control for the transient analysis of brushless dc motor	Application Analysis
	EE445.4	Able to know about the basic principles and classification of servo motors	Comprehension Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE445.1	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**2**	**1**	**2**
EE445.2	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**2**	**1**	**2**
EE445.3	**3**	**2**	**2**	**2**	**2**	**2**	**1**		**2**			**3**	**2**	**1**	**2**
EE445.4	**3**	**1**	**2**	**1**	**2**	**2**	**1**		**1**			**3**	**2**	**1**	**2**
EE445	**3.00**	**1.75**	**2.00**	**1.25**	**2.00**	**1.50**	**1.00**		**1.75**			**3.00**	**2.00**	**1.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
I	**Stepper Motor** Introduction, Types, Hybrid stepper motor- construction, principle of operation, two phases energized at a time, conditions for operation, different configurations, VR Stepper motor- single stack and multi stack, Drive systems and circuit for open loop and Closed loop control of stepping motor, Dynamic characteristics, Single phase stepper Motor, Expression of voltage, current and torque for stepper motor and criteria for synchronization.	**12**	**CO1**
II	**Switched Reluctance Motor** Constructional features, principle of operation, Design Aspects and profile of the SRM, Torque equation, Power converters and rotor sensing mechanism, expression of torque and torque-speed characteristics.	**10**	**CO2**
III	**Brushless DC Motor** Construction, operation, sensing and switching logic scheme, Drive and power circuit, Theoretical analysis and performance prediction, transient Analysis, control technique.	**10**	**CO3**
IV	**Servo motors** Types of servomotors, construction, operating principle and application.	**10**	**CO4**
	Total Hours	**42**	

Essential Readings

1. K. Venkataratnam, "Special Electrical Machines", University Press, 2017
2. A. E. Fitzgerald, Charles Kingsley, Stephen D. Umans," Electrical Machinery", McGraw Hill.,2018

Supplementary Readings

3. R. Krishnan, "Switched Reluctance Motor Drives, Modelling, Simulation, Analysis, Design and applications", CRC press, 2016
4. T. J. E Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford. , 2016
5. T. Kenjo and S. Nagamori, "Permanent Magnet and Brushless DC Motors", Clarendon Press, Oxford, 2016
6. T. Kenjo, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford, 2015

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE447	**Substation Engineering**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the electrical substation design.		EE447.1	**Able to acquire knowledge about the design and identification of the traditional and innovative substation of its application**	Knowledge Identification Application
	To teach high voltage switching equipment.		EE447.2	**Able to knowledge and identify the application of high-voltage switching equipment.**	Knowledge Identification
	To develop ability and skill in Bus/Switching configurations		EE447.3	**Able to compute bus/switching configurations and design of switching**	Compute, Design
	To develop the ability and skill to design Substation Grounding, Protection, and Automation.		EE447.4	**Able to design substation grounding and protection systems**	Design
			EE447.5	**Able to knowledge and design of substation automation, communication systems, and SCADA components**	Knowledge Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE447.1	**3**	**3**	**1**	**1**					**2**				**3**		**3**
EE447.2	**3**	**2**		**1**	**3**				**3**				**3**		**3**
EE447.3	**3**	**3**	**3**	**1**		**3**							**2**	**2**	**2**
EE447.4	**3**	**2**	**3**		**2**	**2**	**3**		**2**			**2**	**2**	**2**	**2**
EE447.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**	**3**		**1**	**3**	**3**	**3**
EE447	**2.8**	**2.4**	**2.5**	**1**	**2.3**	**2.3**	**3**		**2.25**	**3**		**1.5**	**2.6**	**2.3**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Background, Need Determination, Budgeting, Financing, Traditional and innovative Substation, Design, Site Selection and Acquisition, Design, Construction and Commissioning Process	**06**	**CO1**
II	**High Voltage Switching Equipment** Ambient conditions, Disconnect switches, Load Break switches, high-speed grounding switches, power fuses, circuit switches, circuit breakers	**06**	**CO2**
III	**Types Of Substations & Bus/Switching Configurations** Transmission substation, distribution substation, collector substation, switching substations, gas insulated substations, air insulated substations, bus configurations: single bus, double bus, double break, main and transfer bus, double bus, single breaker, ring bus, break-and-a-half, Comparison of configurations.	**10**	**CO3**
IV	**Design Of Substation Grounding and Protection** Reasons for substation grounding system, accidental ground circuit, Design criteria-Actual Touch and step voltage, soil resistivity, grid resistance, grid current, use of the design equations, selection of conductors, grounding fence, other design considerations. Lightning stroke protection-lightning parameters, empirical design methods. Substation fire protection-Fire hazards, fire protection measures, fire protection selection criterion	**10**	**CO4**
V	**Substation Automation and Communications** Introduction, components of substation automation system, automation applications, protocol fundamentals, supervisory control and data acquisition (SCADA) historical perspective, SCADA, functional requirements, SCADA communication requirements, components of SCADA system, SCADA, communication protocols, the structure of a SCADA communication protocol, security for substation, communications, security methods, security assessment.	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. John D. McDonald, Electrical Power Substation Engineering, CRC Press, 3rdEdition, 2017.

Supplementary Readings

1. R. S. Dahiya, VinayAttri,"Sub-Station Engineering Design & Computer Applications" S K Kataria and sons Publications, 1st Edition, 2013.
2. P. S. Satnam, P. V. Gupta, "Substation Design and Equipment" Dhanapat Rai Publications, 1st Edition, 2013.
3. Turan Gonen, "Electric Power Distribution Engineering" CRC press, third edition, 2014.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE449	**Flexible UAV Design**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce basic concepts of flexible UAV design and algorithms.		EE449.1	**Able to acquire knowledge about flexible UAV design and algorithms and their applications.**	Knowledge Application
	To discuss the performance and stability of wing contributed flexible UAV		EE449.2	**Able to compute the performance and stability of wing contributed flexible UAV**	Compute
	To discuss the performance and stability of wing-tail contributed flexible UAV		EE449.3	**Able to compute and analyze the performance and stability of wing-tail contributed flexible UAV**	Compute Analyze
	To develop skill about weight estimation and wing sizing of UAV		EE449.4	**Able to estimate weight and compute wing size of UAV**	Estimate Compute

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE449.1	**3**	**3**	**2**	**1**	**2**	**2**			**2**			**2**	**3**	**2**	**2**
EE449.2	**3**	**3**	**2**	**1**	**1**	**2**			**2**			**1**	**2**	**2**	**2**
EE449.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**					**2**	**3**	**3**	**3**
EE449.4	**3**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE449	**2.75**	**2.75**	**2.50**	**1.25**	**1.75**	**2.00**	**2.50**		**2.00**			**1.50**	**2.75**	**2.50**	**2.50**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Design Algorithms** Flight Dynamics Point of View, Thrust Generation and Power Required, Lift and Drag for Infinite Wing, Relation between Aerodynamic center and Center of pressure, Aerodynamic Characteristics of Wing, Stability and Criteria for Longitudinal Static Stability	**10**	**CO1**
II	**Longitudinal Static Stability** Longitudinal Static Stability-Wing Contribution, Flight Demonstration of Flat Plate and Illustrative Examples, Example Problems for Wing alone Configuration, Wing-Tail Contribution and Neutral Point	**11**	**CO2**
III	**Wing and tail combination** Wing and tail combination Example, Flight demonstration of same wing and tail combination, Trim Requirements of UAV, Example on performance analysis of UAV	**10**	**CO3**
IV	**Weight Estimation and wing Sizing** Weight Estimation and wing Sizing Example, Power Plant Selection with Example, Subroutine for takeoff performance, Subroutine for Climb Performance, Subroutine for Weight Estimation, Subroutine for Planform Geometry Selection, Subroutine for Airfoil Selection	**11**	**CO4**
	Total Hours	**42**	

Essential Readings

1. John D. Anderson, Introduction to Flight, McGraw-Hill, 1945.
2. Bandu N. Pamadi, Performance, Stability, Dynamics, and Control of Airplanes, American Institute of Aeronautics and Astronautics Publishing Company Inc., 2015.
3. John D. Anderson, Aircraft performance and design, Tata McGraw-Hill, 2010.

Supplementary Readings

1. Mohammad H. Sadraey, Unmanned Aircraft Design: A review of fundamentals, Springer Cham, 2017.
2. J. Gundlach, Designing Unmanned Aircraft Systems: A comprehensive Approach, American Institute of Aeronautics and Astronautics Publishing Company Inc., 2012.
3. Daniel P. Raymer, Aircraft Design: A Conceptual Approach, American Institute of Aeronautics and Astronautics Publishing Company Inc., 2018.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE471	**Energy Internet**		**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand an innovative concept that changes the way people generate, distribute, and consume electrical energy.		EE471.1	**Able to understand the concept of Energy Internet and associated key technologies**	Understand
	To develop an understanding of the Energy Internet that includes a thorough dissemination of case studies from the USA, China, Japan, Germany, and the U.K.		EE471.2	**Able to understand electricity market paradigms within the energy internet**	Understand
			EE471.3	**Able to understand the blockchain technology on the energy internet.**	Understand
			EE471.4	**Able to understand the application of data encryption methods for Energy Internet:**	Understand Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE471.1	**3**	**3**	**2**	**1**		**1**	**1**					**1**	**3**		**1**
EE471.2	**3**	**3**	**3**	**2**	**2**	**1**	**2**					**1**	**3**		**2**
EE471.3	**3**	**3**	**3**	**3**	**3**	**1**	**3**					**1**	**3**		**2**
EE471.4	**3**	**3**	**3**	**3**	**3**	**1**	**3**					**2**	**3**		**2**
EE471	**3**	**3**	**2.75**	**2.25**	**2**	**1**	**2.25**					**1.25**	**3**		**1.75**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Energy Internet:** Introduction to Energy Internet, Understand the definition, Characteristics, Global Power and Energy Internet Architecture, Key technologies, Energy management approaches in energy networks, Energy Routers, Characteristics of communication networks of Energy Internet network, Energy Internet and Industry 4.0, Representative demonstration projects.	**08**	**CO1**
II	**Electricity Market Reform:** Introduction, Electricity market paradigms within energy internet: internetwork trading with P2P models, Indirect customer-to-customer trading, Prosumer community groups, Transactive energy as a platform for energy transactions: Motivation and definition of transactive electrical grid, TE framework, Energy transactions and business model innovations, Challenges and future development of transactive energy, Rise of the community microgrid, The Brooklyn microgrid demonstration, Next steps for exergy and Brooklyn microgrid, DER participants, Multi-micro-grid systems.	**05**	**CO2**
IV	**Blockchain Technology on the Energy Internet:** Introduction to IoT, The role of IoT in energy management and smart grids, Blockchain Technology and Energy Internet, Application of blockchain technology in energy scenarios, Application case analysis of blockchain technology in the energy industry: TransActive Grid (USA), Power Ledger (Australia), Energy Blockchain Lab (China), Challenges in the application of blockchain technology in the energy industry: Technical & Policy Challenges, Evolution of Digital Grid, Benefits of Digital Grid, Relief from power grid constraints, Digital grid routers transaction of the tagged real power, Machine-to-machine autonomous power market using blockchain, Implementation of Digital Grid in real-world with examples.	**10**	**CO3**
V	**Emerging Data Encryption Methods for Energy Internet:** Introduction, Importance of digital signatures in the Energy Internet, Secret key cryptography (symmetric key cryptography), Public key cryptography (asymmetric key cryptography), Quantum key distribution, Application of quantum key distribution to the Energy Internet, Comparison of different cryptography methods- pros and cons, Future trends and opportunities in cyber security.	**05**	**CO4**
	Total Hours	**28**	

Essential Readings

1. Wencong Su, Alex Huang, "The Energy Internet: An Open Energy Platform to Transform Legacy Power Systems into Open Innovation and Global Economic Engines", Woodhead Publishing Series, 2018.
2. Ahmed F Zobaa, Junwei Cao, "Energy Internet: Systems and Applications", Springer Cham, 2020.

	National Institute of Technology Meghalaya An Institute of National Importance		MAPPING & EVALUATION SCHEME
Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C			END	Total
EE475	**Summer Internship 2**	**0**	**0**	**0**	**1**			**100**	**100**

		After the completion of the course, the student should be able to:		
Course Objectives	**To familiarize about organization structure of the industry**	**Course Outcomes**	**EE475.1**	**Understand the organization structure of the industry and focus on skill enhancement**
	To develop skill on training task		**EE475.2**	**Prepare a well-organized training tasks**
	To prepare and present the training report and present via power point presentation		**EE475.3**	**Deliver a constructive presentation**
			EE475.4	**Prepare effective training report**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	**EE475.1**	3		3		2	2			3	3	3	3	2	3	
2	**EE475.2**										3	3	3		2	3
3	**EE475.3**	3	2							3	2		3	2	2	2
4	**EE475.4**	3	2								3	2	2	3	3	2
Avg. COs		**3.00**	**2.00**	**3.00**		**2.00**	**2.00**			**3.00**	**2.75**	**2.67**	**2.75**	**2.33**	**2.50**	**2.33**

Mapping of COs with Knowledge Level (KL)

CO1	K3 : Applying
CO2	K3 : Applying; K4 : Analysing
CO3	K3 : Applying
CO4	K3 : Applying
CO5	

Training Evaluation Scheme (END)

Items	**Internship Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	CO1	CO2, CO3	CO3, CO4	CO3	CO2, CO3, CO4	CO5	CO2, CO3, CO5	CO3, CO4	CO5		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100

	National Institute of Technology Meghalaya An Institute of National Importance		MAPPING & EVALUATION SCHEME
Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C		MID	END	Total
EE481	**Major Project-1**	**0**	**0**	**8**	**4**		**30/100**	**70/100**	**100**

			COs	**Statement**
		After the completion of the course, the student should be able to:		
Course Objectives	**To introduce the basic concepts for preparing proposal on engineering and technology**	**Course Outcomes**	EE481.1	**Use critical and creative thinking to prepare proposal on engineering and technology**
	To teach the use modern engineering tools model, fundamental knowledge, and skills to develop methodology or prototype		EE481.2	**Design the system components and use the appropriate modern engineering tools**
	To develop skills to prepare and present the technical report and present via power point presentation		EE481.3	**Apply fundamental knowledge and skills to develop methodology or prototype as a team**
			EE481.4	**Incorporate the suggestions made to improve the project quality for societal and environmental contexts**
			EE481.5	**Demonstrate the project and prepare technical report as a team**

COs	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE481.1	1	3	3		3		3	2	3	3	3	3	3	3	2
EE481.2	3	3	3		2		3	3	2	3	3	2	2	3	3
EE481.3	2	1	1	3	1	2	1				2	3	2	3	3
EE481.4	3			3	2	3	2			2	1	2	1	2	1
EE481.5	1	1	1		1	2	3	3	2	3	2	2	2	2	1
Avg. EE481	**2.00**	**2.00**	**2.00**	**3.00**	**1.80**	**2.33**	**2.40**	**2.67**	**2.33**	**2.75**	**2.20**	**2.40**	**2.00**	**2.60**	**2.00**

Mapping of COs with Knowledge Level (KL)	
EE481.1	K3 : Applying
EE481.2	K3 : Applying; K4 : Analysing
EE481.3	K4 : Analysing; K5 : Evaluating
EE481.4	K6 : Creating
EE481.5	K3 : Applying

Project Evaluation Scheme (MID/END)

Items	**Project Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	EE481.1	EE481.2 EE481.3	EE481.3 EE481.4	EE481.3	EE481.2 EE481.3 EE481.4	EE481.5	EE481.2 EE481.3 EE481.5	EE481.3 EE481.4	EE481.5		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100

4^{th} Year: Semester-8

B.Tech - Electrical and Electronics Engineering

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE412	**Power System Dynamics**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce stability, dynamical modeling and stability problems.		EE412.1	**Able to acquire knowledge about concepts of system stability and dynamics and identification of its application.**	Knowledge Identification Application
	To teach modeling of excitation and prime mover systems, and transmission lines and loads,		EE412.2	**Able to acquire knowledge about models for synchronous machines and related control systems and identification of applications.**	Knowledge Identification Application
	To develop ability and skill to develop an understanding of excitation and prime mover systems modeling.		EE412.3	**Able to compute the performance of transmission lines and loads in power systems.**	Compute Design
	To develop ability and skill stability issues in interconnected power systems.		EE412.4	**Able to design transmission line characteristics, load models, HVDC systems, and protection systems.**	Design
			EE412.5	**Able to design stability issues in interconnected power systems.**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE412.1	3	2	2	2	3							1	3	2	1
EE412.2	3	3	3	3	3							2	3	2	2
EE412.3	3	2	2	2	3							1	3	2	1
EE412.4	3	2	3	3	3							1	3	2	1
EE412.5	3	2	2	2	3		2	2	2			1	3	2	1
EE412.6															
EE412	3	2.2	2.4	2.4	3		2	2	2				1.2	3	2

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Power System Stability and Dynamical** Power System Operation and Control, Stability Problems faced by Power Systems, Impact on Power System Operation and Control, Concept of Equilibria, Small and Large Disturbance Stability, Example: Single Machine Infinite Bus System, Modal Analysis of Linear Systems, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff Systems.	**06**	**CO1**
II	**Modeling of a Synchronous Machine** Physical Characteristics, Rotor Position Dependent model, D-Q Transformation, Model with Standard Parameters. Steady State Analysis of Synchronous Machine, Short Circuit Transient Analysis of a Synchronous Machine, Synchronous Machine Connected to Infinite Bus.	**10**	**CO2**
III	**Modeling of Excitation and Prime Mover Systems** Physical Characteristics and Models, Control system components, Excitation System Controllers, Prime Mover Control Systems	**08**	**CO3**
IV	**Modeling of Transmission Lines and Loads** Transmission Line Physical Characteristics, Transmission Line Modeling, Load Models - induction machine model, Other Subsystems - HVDC, protection systems.	**08**	**CO4**
V	**Stability Issues in Interconnected Power Systems** Single Machine Infinite Bus System, Multi-machine Systems, Stability of Relative Motion, Frequency Stability: Centre of Inertia Motion, Concept of Load Sharing: Governors, Single Machine Load Bus System: Voltage Stability, Torsional Oscillations.	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. K.R.Padiyar, Power System Dynamics, Stability & Control, 2nd Edition, B.S. Publications, Hyderabad, 2002.
2. P.Kundur, Power System Stability and Control, McGraw Hill Inc, New York, 1995.
3. P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.

Supplementary Readings

1. Jan Machowski , Janusz W Bialek, "Power System Dynamics: Stability and Control", John Wiley.
2. Elgerd O I, "Electric Energy Systems Theory An Introduction", Tata McGraw-Hill.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE414	**Transactive Energy Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To teach the basic concepts, components, and architecture of smart grid.		EE414.1	Able to understand Transactive Energy (TE)	Understand
	To familiarize the students with the new technologies for grid-interfaced DG system with storage.		EE414.2	Able to understand TE Architecture and Framework	Understand
	To explain the communication technologies and the cyber-security threats in Smart Grid.		EE414.3	Able to understand TE Technology and develop energy flow frameworks.	Understand Develop
	To teach the fundamental requirements for planning ancillary services in Smart Grid.		EE414.4	Able to understand Blockchain-Enabled Transactive Energy.	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE414.1	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**					**3**		
EE414.2	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**					**3**		**1**
EE414.3	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**		**1**		**1**	**3**		**2**
EE414.4	**3**	**3**	**3**	**3**	**3**	**1**		**1**					**3**		**3**
EE414.5	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**1**		**2**			**3**		**3**
EE441	**3**	**3**	**2.6**	**2.4**	**2.6**	**1.2**	**1.2**	**1**		**0.6**		**1**	**3**		**1.8**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Transactive Energy (TE):** Basic understanding of TE system, definition, fundamental concept, Potential impact of TE, Applications for Utilities and Distribution System Operators, Duck curve, Customer Applications, Role of DER participants and Prosumers.	**10**	**CO1**
II	**TE Architecture and Framework:** Transactive energy attributes, transactive energy principles, the evolution of the grid and its impact on transactive energy, Strata of TE, elements of TE, Transactive Energy Products, Market Participant, framework, policy and market design, Business Models and Value Realization: Overview of DER Services and Technical Capabilities, DER Services and Values Recognized Today, Pilot Projects with Transactive Control.	**10**	**CO1 CO2**
III	**Transactive Energy Technology:** Introduction, TE application in the operation of energy networks, TE application in consumer-side, TE application in energy trading strategies, TE application in multi-energy systems, role of DSO & TSO and their interactions, LMP Vs DLMP, Double auction mechanism, Different transactive energy model, energy trading between WM and LM, day-ahead market and real-time market, penalty mechanism, risk mitigation mechanism, End-to-End Transactive Solutions, Optimization tools, P2P trading, Multi-microgrid, Brooklyn microgrid, Power loss in P2P energy flow, Transactive Feeder (front-of-meter), Transactive Home & Building (behind-the-meter), Transactive Building-to-Grid (B2G).	**12**	**CO3**
IV	**Blockchain-Enabled Transactive Energy:** Introduction, Characteristics of blockchain, Types and generations of blockchains, Blockchain operation and its applications in the energy sector, Benefits of Blockchain in Energy Trading, P2P energy trading in residential distribution network, Tokenization of energy assets, Energy management, Network constraints, Blockchain pilot projects in India.	**10**	**CO4**
	Total Hours	**42**	

Essential Readings

1. GridWise Architecture Council, "GridWise Transactive Energy Framework," Oct.2013
2. Behnam Mohammadi-Ivatloo, Kazem Zare, Mohammadreza Daneshvar, "Emerging Transactive Energy Technology for Future Modern Energy Networks", Academic Press Inc, 2022.
3. J. Lian, K. Kalsi, J. C. Fuller and K. Subbarao, "Transactive Control Framework for Heterogeneous Devices." US Application US14/788,473, filed on June 30, 2015.
4. J. Lian, D. Wu, K. Kalsi, J. Hansen, L. Marinovici and T. Hardy, "Hierarchical Framework for Integrating Distributed Energy Resources into Distribution Systems." US Application US16/035,377, filed on July 13, 2018
5. Tiago Pinto, Zita Vale, Steve Widergren, "Local Electricity Markets", 1st Edition, Elsevier, July 2021.

Supplementary Readings

1. Miadreza Shafie-khah, Amin Shokri Gazafroudi, "Trading in Local Energy Markets and Energy Communities: Concepts, Structures and Technologies", Springer, 2023.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE416	**Power Quality Measures and Remedies**	**EE416**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To deliver fundamental concept on power quality, its classifications and related problems.	Course Outcomes	EE416.1	**Able to demonstrate knowledge and understanding of concepts and basic principles of power quality.**	Knowledge Identification Application
	To gather knowledge on power assessment techniques and power quality standards.		EE416.2	**Able to evaluate the severity of sag, swell, harmonics, and transients in single and three-phase distribution networks**	Knowledge Identification Application
	To discuss the waveform processing techniques and harmonics in power system.		EE416.3	**Able to understand power quality monitoring, assessment and classification techniques.**	Compute, Design
	To familiarize the concept of Harmonic Mitigation.		EE416.4	**Able to illustrate and describe solutions for different power quality problems and waveform processing technique.**	Design
			EE416.5	**Able to analyze effects of harmonics and power system harmonic distortion**	Design
			EE416.6		

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE416.1	**3**	**3**		**1**					**2**				**3**		**3**
EE416.2	**3**	**3**		**1**					**2**				**2**		**2**
EE416.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE416.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE416.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE416.6															
EE416	**2.40**	**2.60**	**3.00**	**1.00**	**2.00**	**2.00**	**3.00**		**2.00**			**1.00**	**2.40**	**3.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Power quality, voltage quality – overview of power quality phenomena – classification of power quality issues – power quality measures and standards – THD-TIF-DIN-flicker factor-transient phenomena – occurrence of power quality problems – power acceptability curves – IEEE guides, EMC standards and recommended practices	**06**	**CO1**
II	**Power Assessment under Waveform Distortion** Introduction – single phase definitions, three phase definitions – illustrative examples., Fundamental frequency characterization – Fourier analysis, Fast Fourier Transform, window functions, efficiency of FFT algorithms– alternative transforms, wavelet transform, Hartley transform – automation of disturbance recognition.	**10**	**CO1**
III	**Power Quality Monitoring** Introduction, transducers, CT, PT – power quality instrumentation – Harmonic monitoring – event recording – flicker monitoring, assessment of voltage and current unbalance – examples of application.	**05**	**CO1** **CO2**
IV	**Evaluation of Power System Harmonic Distortion** Introduction – direct harmonic analysis – incorporation of harmonic voltage sources – derivation of network harmonic impedances – solution by direct injection – representation of individual power system components – implementation of harmonic analysis – post processing and display of results.	**10**	**CO2** **CO3** **CO4**
V	**Harmonic Mitigation** Passive filtering – harmonic resonance – impedance scan analysis – active power factor correction – introduction to three phase APFC and control techniques.	**05**	**CO4** **CO5**
	Total Hours	**36**	

Essential Readings

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso "Electrical Power System Quality", Tata Mcgraw-hill, New Delhi, 1 st edition, 2012.
2. Math H Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", Wiley-IEEE Press, 1 st edition, 1999.
3. Jos Arrillaga, Neville R. Watson, S. Chen, "Power System Quality Assessment", John Willey, 1 st edition , 2000.

Supplementary Readings

1. Jos Arrillaga, Bruce C. Smith, Neville R. Watson, Alan R. Wood, "Power System Harmonic Analysis", John Wiley, 1 st edition , 1997.
2. Roger C. Dugan, Surya Santoso, Mark F. McGranaghan, H. Wayne Beaty, "Electrical Power System Quality", McGraw Hills, 1 st edition , 2002.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE418	**Modelling and Analysis of Electrical Machines**	**NO**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- Introducing the mathematical modelling of different AC and DC machines
- Study the behaviour of different motors at different operating conditions.
- Give the knowledge of the controlling techniques of different motors.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE418.1	To develop the dynamic model of dc machines and analyze them.	Knowledge Application
EE418.2	To do the analysis of three phase coordinate system into two phase coordinate.	Comprehension Synthesis
EE418.3	To understand the dynamic model of induction and analyze its different control technique.	Application Analysis
EE418.4	To develop the dynamic model of synchronous machines and analyze its different characteristics.	Comprehension Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE418.1	**3**	**2**	**1**	**1**	**2**	**1**	**1**		**2**			**3**	**3**	**1**	**2**
EE418.2	**3**	**1**	**1**		**1**				**2**			**3**	**2**		**2**
EE418.3	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**3**	**1**	**2**
EE418.4	**3**	**2**	**2**	**1**	**2**	**1**	**1**		**2**			**3**	**3**	**1**	**2**
EE418	**3.00**	**1.75**	**1.50**	**1.00**	**1.75**	**1.00**	**1.00**		**2.00**			**3.00**	**2.75**	**1.00**	**2.00**

SYLLABUS

No.	Content	Hours	COs
I	**DC Machine Modeling** Dynamic equation of different types of DC machine, Small signal model of DC machine, Small signal behaviour of DC machines, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor.	**10**	**CO1**
II	**Reference Frame Theory** Real time model of a two phase induction machine, transformation to obtain constant matrices, three phase to two phase transformation, Clarke transformation, Park transformation, power equivalence.	**08**	**CO2**
III	**Modelling of Three Phase Induction Machine** Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation. Small Signal Equations of the Induction Machine: Derivation of small signal equations of induction machine, space phasor model, dq flux linkages model derivation, control principle of the induction motor.	**12**	**CO3**
IV	**Modeling of Synchronous Machines** Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation, dynamic equation of salient pole synchronous machine, modelling of salient pole synchronous machine.	**12**	**CO4**
	Total Hours	**42**	

Essential Readings

1. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India, 1st edition, 2001
2. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, 2nd Edition, 2010..

Supplementary Readings

1. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, " Electric Machinery",Tata McGraw Hill, 5th Edition, 1992
2. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 7th edition, 2021.
3. Chee-MunOng, "Dynamic Simulation of Electric Machinery using Matlab / Simulink",Prentice Hall, 1st Edition, 1997.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE452	**Energy Grid Resilience**	**EE301**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce microgrids, and networked microgrids		EE452.1	**Understand the concepts of microgrids, and networked microgrids**	Knowledge Identification Application
	To teach the centralized control and distributed control in microgrids		EE452.2	**Model PV power systems and standard grid-tied inverter**	Knowledge Identification Application
	To develop ability and skill to design microgrids		EE452.3	**Understand centralized control and distributed control in microgrids, especially primary, secondary and tertiary control**	Compute, Design
	To develop cybersecurity in microgrids and active defense strategy		EE452.4	**Conduct power flow analysis for droop-control-based microgrids and networked microgrids**	Design
			EE452.5	**Understand fault ride-through and active fault management for microgrids.**	Design
			EE452.6	**Understand basics of cybersecurity in microgrids and active defense strategy**	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE304.1	**3**	**3**		**1**					**2**				**3**		**3**
EE304.2	**3**	**3**		**1**					**2**				**2**		**2**
EE304.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE304.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE304.5	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE304.6															
EE304	**2.40**	**2.60**	**3.00**	**1.00**	**2.00**	**2.00**	**3.00**		**2.00**			**1.00**	**2.40**	**3.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Power systems resilience, The concept of microgrids	**02**	**CO1**
II	**Microgrid Modelling and Analysis** Distributed energy resources (DERs) modelling I: PV system, MPPT, and grid-tied interface, Distributed energy resources modelling Microturbine, energy storage and other DERs, Microgrid inverter structures, Distribution power flow, Stability modelling and computation.	**08**	**CO1**
III	**Microgrid Control and Power Flow** Centralized control, Hierarchical principle: Primary, secondary and tertiary control, Distributed control, Microgrid power flow, Networked microgrid power flow.	**06**	**CO1** **CO2**
IV	**Resilient Microgrids through Software Defined Networking** SDN-enabled control and communication architecture, Distributed regulation of networked microgrids, Hardware-in-the-loop testbed, Formal analysis of microgrid dynamics, Stability margin analysis on networked microgrids.	**08**	**CO2** **CO3** **CO4**
V	**DC Microgrids and Active Fault Management for Networked Microgrids** Overview of DC microgrids , Stability of DC microgrids , Fault ride through, Multi-functional Active Fault Management,	**08**	**CO4** **CO5**
VI	**Cyber Security in Microgrids** Introduction to cyber attacks, Active detection of cyber attacks,	**04**	**CO2** **CO4**
	Total Hours	**36**	

Essential Readings

1. P. Zhang, Networked Microgrids, Cambridge University Press, 2021. ISBN: 9781108497657.
2. Smart Grids, Infrastructure, Technology and Solutions, S. Borlase, CRC Press, 2013, 1st Edition.
3. Renewable and Efficient Electric Power System, G. Masters, Wiley–IEEE Press, 2013, 2nd Edition.

Supplementary Readings

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Power System Stability and Control, P. Kundur, McGraw-Hill, Inc., 1994, 2nd Edition.
3. Y. G. Paithankar and S.R. Bhide, "Fundamentals of Power Systems Protection", PHI, 2nd Edition, 2013.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE454	**Industrial Automation and Control**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the basic concepts, elements and terminologies of industrial automation and control systems.		EE454.1	**Able to acquire knowledge about the control and automation levels of industry and explain the characteristics of well-known industrial devices.**	Knowledge Explain
	To develop the skill to design compensators/ controllers using analytical and graphical techniques.		EE454.2	**Able to acquire knowledge about the well-known controller, actuators in electronic, pneumatic and hydraulic form.**	Knowledge
	To discuss about the design of a suitable programmable logic controller to meet a desired sequence control requirement.		EE454.3	**Able to design and justify the choice of appropriate control scheme for well-known industrial situations and design the controller to meet the requirement.**	Design Justify
			EE454.4	**Able to design a suitable programmable logic to meet a desired sequence control requirement.**	Design
			EE454.5	**Able to explain the measurement utility and operations in the various devices used for industrial control applications.**	Explain

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE454.1	**3**	**3**	**2**	**1**	**2**	**2**			**2**			**2**	**3**	**2**	**2**
EE454.2	**3**	**3**	**2**	**1**	**1**	**2**			**2**			**1**	**2**	**2**	**2**
EE454.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**					**2**	**2**	**3**	**3**
EE454.4	**3**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**3**
EE454.5	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE454	**2.60**	**2.60**	**2.60**	**1.60**	**1.80**	**2.00**	**2.67**		**2.00**			**1.60**	**2.40**	**2.60**	**2.60**

SYLLABUS

No.	Content	Hours	COs
I	**Basic Concepts** Introduction to industrial automation and control, architecture of industrial automation systems. Functionality of each layer with industrial relevance. Introduction to process flow of different industries. A brief introduction to sensors and measurement systems	**07**	**CO1**
II	**Industrial Actuators** Introduction to actuators: flow control valves, hydraulic actuator systems: principles, components and symbols, pumps and motors, proportional and servo valves, introduction to pneumatic control systems: system components, actuators, and controllers	**09**	**CO2**
III	**Industrial Control Systems** Introduction to process control, PID control, controller tuning, implementation of PID controllers, special control structures: feed forward control, ratio control, predictive control, control of systems with inverse Response, cascade control, overriding control, selective control, split range control, Fuzzy control, controller design for a T-S Fuzzy model, Linear controllers using T-S fuzzy model	**09**	**CO3**
IV	**Programmable Automation** Introduction to sequence control, PLC and relay ladder logic, sequence control, structured design approach, IL, SFC, PLC hardware environment	**09**	**CO4**
V	**Measurement of Physical Variables** Measurement of temperature, pressure, force, displacement, speed, flow, level humidity, pH etc. signal conditioning and processing, estimation of errors and calibration, data acquisition	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Ernest O. Doebelin, "Measurement Systems: Application and Design", McGraw-Hill: New York, 4th Edition, 2010.
2. C. D. Johnson, "Process Control Instrumentation Technology", Pearson Education India, 8th Edition, 2015.
3. J. W. Webb, Ronald A. Reis, "Programmable Logic Controllers – Principles and Applications", Prentice Hall India, 5th Edition, 2002.

Supplementary Readings

1. J. P. Bentley, "Principles of Measurement Systems", Pearson Education India, 4th Edition, 2004.
2. B. E. Bequette, "Process Control – Modelling, Design, and Simulation", Prentice Hall, 2nd Edition, 2003.
3. B. C. Kuo, "Automatic Control Systems", Wiley India, 9th Edition, 2014.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE422	**Advanced Relaying and Protection**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	**To introduce the construction and classification of static relays.**	Course Outcomes	EE422.1 **Able to acquire knowledge of types of protective schemes and identification of its application**	Knowledge Identification Application
	To teach principles of amplitude and phase comparators.		EE422.2 **Able to acquire knowledge about various amplitude and phase comparator techniques and identification of application**	Knowledge Identification Application
	To develop ability and skill of overcurrent relays and distance protection schemes.		EE422.3 **Able to compute the static overcurrent relays and distance protection schemes**	Compute Design
	To develop ability and skill AC machines, bus zones, and the implementation of microprocessor-based protective relays.		EE422.4 **Able to design bus zones, including protection of alternators, and transformers.**	Design
			EE422.5 **Able to design microprocessor-based protective relays for the protection of transmission lines, stations, and substations.**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE422.1	**3**	**3**	**3**	**3**	**3**							**1**	**3**	**2**	**1**
EE422.2	**3**	**3**	**3**	**3**	**3**							**2**	**3**	**2**	**2**
EE422.3	**3**	**3**	**2**	**2**	**3**		**2**	**2**	**2**			**1**	**3**	**2**	**3**
EE422.4	**3**	**2**	**2**	**2**	**3**		**2**	**2**	**2**			**1**	**3**	**2**	**1**
EE422.5	**3**	**2**	**2**	**2**	**3**		**2**	**2**	**2**			**1**	**3**	**2**	**1**
EE422.6															
EE422	**3**	**2.6**	**2.4**	**2.4**	**3**		**2**	**2**	**2**			**1.2**	**3**	**2**	**1.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Basic construction of static relays, Classification of protective schemes, Comparison of Static relays with electromagnetic relays, Amplitude comparator, Phase comparator, Principle of Duality.	**06**	**CO1**
II	**Amplitude and Phase Comparators** Rectifier bridge circulating and opposed voltage type-Averaging-Phase splitting type-Sampling type of amplitude comparison, Block spike type-Phase splitting type-Transistor integrating type-Rectifier bridge type-Vector product type phase comparison	**08**	**CO2**
III	**Static over Current Relays and Distance Protection** Instantaneous-Definite time-inverse time-Directional-IDMT-Very inverse Time-Extremely inverse time overcurrent relays, Time current characteristics of overcurrent relays-Applications, Impedance Relay: Operating principle-Relay characteristic-Protective Schemes-Static Impedance Relay-Static Reactance relay-Static MHO relay-Effect of arc resistance, Effect of power surges, Effect of line length and source impedance on performance of distance relays-Quadrilateral relay-Elliptical relay-Selection of distance relays	**10**	**CO2** **CO3**
IV	**AC Machines and Bus Zone Protection** Protection of Alternators: Stator protection-Rotor protection-Over voltage protection-Over speed protection-Transformer protection: Earth faults in transformers-Percentage differential protection-Protection against magnetic inrush current-Generator and transformer unit protection-Bus zone protection: Differential current protection-High impedance relay scheme-Frame leakage protection.	**10**	**CO4**
V	**Microprocessor-Based Protective Relays** Introduction-Over current relays-Impedance relay-Directional relay-Reactance relay, Protection of transmission lines, stations, and substations against direct lightning strokes-Protection against travelling waves-Insulation coordination.	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. A. T. John and A. K. Salman, "Digital Protection for Power Systems", IEEE Power Series.
2. A. R. Warrington, "Protective Relaying", Chapman and Hall.
3. T. S. Madhav Rao, "Power System Protection: Static Relays with Microprocessor Applications", TMH.

Supplementary Readings

1. S. H. Horowitz and A. G. Phadke, "Power System Relaying", John Wiley.
2. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis-CRC Press.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE424	**Cyber-Security of Energy Systems**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	**To learn about cyber-physical systems in power and energy infrastructure and assess their vulnerability.**	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To learn about risk management, operational security, and secure development of the Smart Grid.		EE424.1	**Able to understand the key technical threat types and communication protocols in energy systems.** — Knowledge Identification Application
			EE424.2	**Able to acquire knowledge about attack vector design and identify vulnerable points in the smart grid.** — Knowledge Identification
			EE424.3	**Able to understand resiliency and cyber-attack concepts and analyse several real-world cyber incidents.** — Understand, Analyse
			EE424.4	**Able to design ML-based detection algorithms for cyber-attacks in power & energy infrastructure.** — Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE424.1	**3**	**3**	**2**	**1**	**2**		**1**	**1**					**3**		**2**
EE424.2	**3**	**3**	**3**	**3**	**2**		**1**	**1**					**3**		**2**
EE424.3	**3**	**3**	**3**	**3**	**2**		**1**	**1**					**3**		**2**
EE424.4	**3**	**3**	**3**	**3**	**3**			**1**					**3**		**2**
EE424	**3**	**3**	**2.75**	**2.5**	**2.25**		**0.75**	**1**					**3**		**2**

SYLLABUS

No.	Content	Hours	COs
I	**Secure Communications:** Introduction to Cyber-Physical Systems, Power and Energy Systems, Smart Grid Architecture, Physical and Network, Two Way Digital Communications Paradigm, Data telemetry, Introduction to SCADA, MTU, HMI, PLCs, RTUs, Physical Communications and Protocols: Modbus; Protocol architecture, IEC 60870-5-101/103/104; DNP 3; Inter-control center protocol (ICCP); Ethernet; IEC 61850, Power System Observability, Bad Data Detection and Identification using State Estimation Results, Cyber Security Challenges in Smart Grid, Importance of Security, Classification of the Threats, Security Analytics for AMI and SCADA, Overview of SMT and Probabilistic Model Checking.	**14**	**CO1**
II	**Cyber-Security in the Smart Grid:** Vulnerable points in the Smart Grid, Cyber-Physical Layer of Energy Infrastructure, IOT and Sensors, Computation/Cyber Aspects of the Grid –AGC, State Estimation (SE), Real-time Contingency Analysis, Security-Constrained Economic Dispatch, Attack Vectors, False Data Injection (FDI) Attacks, DOS Attacks, Replay Attack, MITM attack, Load Altering Attacks, Security of V2G Connections, Anomaly Detection & Mitigation Mechanism, Model-Based Methods for Attack Identification.	**10**	**CO2**
IV	**Resiliency and Cyber-Attack:** Types of Physical Attack, Basic Protection Mechanisms, Hardware Security Modules, Integrity Protection and Attestation, Analytics for Security and Resiliency, Cyber Security Solutions for Control and Monitoring System, Secure Communication: Network protocols and standards, Cyber-Secure and Resilient Architectures for Industrial Control Systems, Case Studies: Ukraine Cyberattack Case Study, European ENTSO-E Cyberattack Case Study, Iranian Fuel Cyberattack Case Study, Korea Hydro and Nuclear Power Case Study and others.	**10**	**CO3**
V	**Machine Learning for Cyber Security:** ML-based Defense Mechanism: SVM, Nearest Neighbor, Recurrent Neural Networks, and LSTMs, Other Data-Driven Based Methods for Attack Identification.	**08**	**CO4**
	Total Hours	**42**	

Essential Readings

1. J. A. Momoh, "Smart Grid: Fundamentals of Design and Analysis," Wiley-IEEE Press, 1st Edition, March 2012.
2. Florian Skopik, Paul Dr. Smith, "Smart Grid Security", Syngress, 2015, ISBN: 9780128023549.
3. C. -W. Ten, G. Manimaran and C. -C. Liu, "Cybersecurity for Critical Infrastructures: Attack and Defense Modeling," in IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, vol. 40, no. 4, pp. 853-865, July 2010.
4. Ehab Al-Shaer, Mohammad Ashiqur Rahman, "Security and Resiliency Analytics for Smart Grids: Static and Dynamic Approaches", 1st Edition, Springer International Publishing AG, 2016.
5. S. Sridhar, A. Hahn and M. Govindarasu, "Cyber–Physical System Security for the Electric Power Grid," in Proceedings of the IEEE, vol. 100, no. 1, pp. 210-224, Jan. 2012.

Supplementary Readings

1. Hassan Haes Alhelou, Nikos Hatziargyriou, Zhao Yang Dong, "Power Systems Cybersecurity: Methods, Concepts, and Best Practices, Springer, 2023.
2. A. Ashok, M. Govindarasu and J. Wang, "Cyber-Physical Attack-Resilient Wide-Area Monitoring, Protection, and Control for the Power Grid," in Proceedings of the IEEE, vol. 105, no. 7, pp. 1389-1407, July 2017.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE426	**Digital Image Processing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To learn the selection of enhancement techniques in image processing		EE426.1	Able to acquire knowledge about image enhancement in spatial domain	Knowledge Understand
	To develop ability and skill to apply filtering methods in image processing		EE426.2	Able to acquire knowledge about image enhancement in frequency domain	Knowledge Understand Apply
	To learn color and morphological analysis image processing		EE426.3	Able to apply functions and filtering techniques for image restoration	Understand Evaluate Apply
	To learn segmentation methods in image processing		EE426.4	Able to understand color and morphological processing	Understand Evaluate Apply
			EE426.5	Able to employ design, detection and segmentation techniques	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE426.1	**3**	**3**	**3**	**2**		**1**			**1**			**1**	**2**	**1**	**3**
EE426.2	**3**	**3**	**3**	**2**		**1**			**1**			**1**	**2**	**1**	**3**
EE426.3	**3**	**3**	**2**	**2**	**2**	**1**			**1**			**1**	**2**	**1**	**3**
EE426.4	**3**	**3**	**3**	**2**	**2**	**1**			**2**			**1**	**2**	**1**	**2**
EE426.5	**3**	**3**	**2**	**2**	**1**	**1**			**1**			**1**	**2**	**1**	**3**
EE426	**3**	**3**	**2.6**	**2**	**1.66**	**1**			**1.4**			**1**	**1**	**1**	**2.8**

SYLLABUS

No.	Content	Hours	COs
I	**Module 1: IMAGE ENHANCEMENT IN SPATIAL DOMAIN** Gray-level transformations, histogram equalization, spatial filters averaging, order statistics; Edge detection - first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussion masks	**08**	**CO1**
II	**Module 2: IMAGE FILTERING IN FREQUENCY DOMAIN:** One and two-dimensional DFT, properties of 2-D DFT, periodicity properties, convolution and correlation theorems, Fast Fourier Transforms, Smoothing and sharpening filtering in frequency domain, Butterworth filters and homomorphic filtering	**09**	**CO2**
III	**Module 3: IMAGE RESTORATION:** Degradation/restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering, geometric transformations	**09**	**CO3**
IV	**Module 4: COLOR AND MORPHOLOGICAL IMAGE PROCESSING:** Color image - processing, transformation, segmentation, noise in color images; dilation, erosion, opening, closing, Hit-Miss transformations; Basic morphological algorithms - boundary extraction, region filling, connected components, convex hull, thinning, thickening, skeletons, pruning, and extensions to gray-scale morphology	**08**	**CO4**
V	**Module 5: IMAGE SEGMENTATION:** Boundary detection; Hough transforms, graph-theoretic techniques, thresholding; Segmentation - region based, morphological watersheds and motion based segmentations	**08**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education, 2nd edition 2003
2. William K Pratt, "Digital Image Processing", John Willey, 2nd edition 2006
3. Chanda Dutta Magundar, "Digital Image Processing and Applications", PHI, 2nd edition 2000

Supplementary Readings

1. C. Phillips, "Image Processing in C", BPB Publication, 1st edition 1995
2. B. Chanda, D. Dutta Majumdar, "Digital Image processing and Analysis", PHI, 2nd edition 2011

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE428	**Internet of Things**	**EE428**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	
	To provide the students with some knowledge about the definition and significance of the Internet of Things.
	To develop the student's ability to understand the architecture, operation, and business benefits of an IoT solution.
	To develop the student's ability to understand different protocols used for communication between various IoT devices.
	To develop the student's ability to understand the relationship between IoT, cloud computing, and big data.

Course Outcomes		
	CO's	**Statement**	**Bloom's Taxonomy**
	EE428.1	**Able to demonstrate the basic concept of IoT, the architecture of IoT, and applications of IoT in the real life.**	Knowledge Identification Application
	EE428.2	**Able to explain the mechanism of various protocols used in different layers of IoT.**	Knowledge Identification Application
	EE428.3	**Able to identify the challenges of Interoperability and techniques used for Interoperability in IoT.**	Compute, Design
	EE428.4	**Able to examine different Service and Resource Discovery in IoT**	Design
	EE428.5		
	EE428.6		

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
EE428.1	**3**	**3**		**1**					**2**				**3**		**3**
EE428.2	**3**	**3**		**1**					**2**				**2**		**2**
EE428.3	**2**	**3**	**3**	**1**	**2**								**2**	**3**	**2**
EE428.4	**2**	**2**	**3**		**2**	**2**	**3**		**2**			**1**	**2**	**3**	**2**
EE428.5															
EE428.6															
EE304	**2.40**	**2.60**	**3.00**	**1.00**	**2.00**	**2.00**	**3.00**		**2.00**			**1.00**	**2.40**	**3.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** What is IoT, Ad-hoc and Sensor Networks, Architecture of IoT, Application of IoT: Smart home, Intelligent transportation systems, Industrial automation, Smart grids;	**08**	**CO1**
II	Introduction to IoT, Sensing, Actuation, Basics of Networking Wifi, Bluetooth, Zigbee Communication Protocols, Sensor Networks.	**08**	**CO1**
III	Sensor Networks, Machine-to-Machine Communications. Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino and Rasberry Phi .	**12**	**CO1 CO2**
IV	Introduction to Python programming, Introduction to Raspberry. Implementation of IoT with Raspberry Pi, Introduction to SDN. SDN for IoT, Data Handling and Analytics, Cloud Computing.	**12**	**CO2 CO3 CO4**
	Total Hours	**36**	

Essential Readings

1. Cirani S, Ferrari G, Picone M, Veltri L. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons; 2018.
2. Lea P. Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security. Packt Publishing Ltd; 2018.
3. Buyya R, Dastjerdi AV, editors. Internet of Things: Principles and paradigms. Elsevier; 2016.

Supplementary Readings

1. Chou T. Precision-Principles, Practices and Solutions for the Internet of Things. McGraw-Hill Education; 2017.
2. Santos M, Moura E. Hands-On IoT Solutions with Blockchain: Discover how converging IoT and blockchain can help you build effective solutions. Packt Publishing Ltd; 2019.
3. Al-Fuqaha A, Guizani M, Mohammadi M, Aledhari M, Ayyash M. Internet of things: A survey on enabling technologies, protocols, and applications. IEEE communications surveys & tutorials. 2015 Jun 15;17(4): 2347-76.

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Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE462	**Cloud Computing**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- **To introduce fundamental concepts and architecture of cloud computing**
- **To develop ability and skills to managing services, resources, and data within cloud environments.**
- **To develop ability and skill to security measures and resource allocation strategies in cloud computing.**
- **To develop the ability and skill to explore advanced topics**

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	EE462.1	**Able to acquire knowledge about Cloud computing and identification of its application**	Knowledge Identification Application
	EE462.2	**Able to acquire knowledge about the architecture of cloud computing, focusing on core components and identification of application**	Knowledge Identification Application
	EE462.3	**Able to compute data and resource management in cloud computing**	Compute Design
	EE462.4	**Able to design cloud security issues, identity access management**	Design Identification
	EE462.5	**Able to design advanced topics such as VM provisioning, management, migration**	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE462.1	3	3	1	1				1	2	2			3		3
EE462.2	3	2		2	3				3	2			3		3
EE462.3	3	3	3	1		3		1		3			2	2	2
EE462.4	3	2	3		2	2	3		2	2		2	2	2	2
EE462.5	3	3	3	2	2	2	3	1	2	2		1	3	3	3
EE462	**3**	**2.6**	**2.5**	**1.5**	**2.3**	**2.3**	**3**	**1**	**2.2**	**2.2**		**1.5**	**2.6**	**2.3**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Cloud Computing** Definition and characteristics, Evolution and history, Benefits and challenges, Cloud service models (IaaS, PaaS, SaaS), Deployment models (Public, Private, Hybrid, and community)	**06**	**CO1**
II	**Cloud Computing Architecture and Service Management** Cloud Computing Architecture, Core components and architecture, Virtualization technology, Cloud infrastructure management, Scalability and elasticity, Service Management in Cloud Computing, Service Level Agreements (SLAs) Cloud service lifecycle, Billing and pricing models, Monitoring and management tools.	**08**	**CO2**
III	**Data and Resource Management in Cloud Computing** Data storage options (block, file, object storage), Database services in the cloud, Big Data and cloud integration Data replication and consistency, Resource allocation and provisioning, Load balancing and auto-scaling, Performance monitoring and optimization, Cost management and optimization	**08**	**CO3**
IV	**Cloud Security and Emerging Trends** Cloud Security, Security challenges in the cloud, Identity and access management, Data encryption and protection, Compliance and regulatory issues, Overview of open-source cloud platforms (OpenStack, CloudStack), Commercial cloud providers (AWS, Azure, Google Cloud), Cloud simulation tools and environments, Current research areas in cloud computing, Introduction to fog computing, Fog vs. cloud computing, Applications and case studies of fog computing	**10**	**CO4**
V	**Advanced Topics and Case Studies** Virtual machine (VM) provisioning and management, VM migration and consolidation, Resource scheduling and monitoring, Integration of cloud, fog, and edge computing, Data analytics in distributed environments, Real-time analytics and processing, Introduction to serverless computing, Function-as-a-Service(FaaS) model, Advantages and use cases of serverless architectures, Case studies of cloud implementations, Recent advancements in cloud technologies, Future trends and directions in cloud computing	**10**	**CO5**
	Total Hours	**42**	

Essential Readings

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
2. Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
3. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

Supplementary Readings

1. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE464	**Artificial Intelligence and Machine Learning**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	Understand with basic principles of AI/ML and apply them to real-world problems.		EE464.1	**Able to gather knowledge about different AI and ML methods and identification of different AI and ML techniques' application**	Knowledge Identification Application
	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks, and other machine learning models.		EE464.2	**Able to acquire knowledge about supervised, unsupervised, and Reinforcement Learning approaches and identification of its application**	Knowledge Identification Application
			EE464.3	**Able to understand and design neural networks and deep learning for electrical engineering problems.**	Understand Design
			EE464.4	**Able to design Reinforcement learning-based classification and regression approaches**	Design
			EE464.5	**Able to design and compute various real-world problems using AI and ML techniques.**	Design Compute

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE464.1	**3**	**3**	**2**	**2**	**2**	**1**						**1**	**1**		**3**
EE464.2	**3**	**3**	**3**	**2**	**3**	**1**						**1**	**1**		**3**
EE464.3	**3**	**3**	**3**	**2**	**3**	**1**						**1**	**1**		**3**
EE464.4	**3**	**3**	**3**	**2**	**3**	**1**						**1**	**1**		**3**
EE464.5	**3**	**3**	**3**	**2**	**3**	**1**						**1**	**1**		**3**
EE464	**3**	**3**	**2.8**	**2**	**2.8**	**1**						**1**	**1**		**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** History, definitions, and applications, different Machine Learning models (Supervised, Unsupervised, Reinforcement Learning), Features and Labels, Training, Testing, and Validation, Evaluation Metrics.	**06**	**CO1 CO2**
II	**Supervised Learning** Introduction to Supervised Learning, Types of Supervised Learning for classification and regression tasks: Linear regression, polynomial regression, Logistic regression, k-nearest neighbours (KNN), decision trees, Support Vector Machine (SVM), Random Forests, and Gradient Boosting Machines, Application of Supervised Learning.	**10**	**CO1 CO2 CO5**
III	**Unsupervised Learning** Introduction to Unsupervised Learning, Types of Unsupervised Learning, Clustering: k-means clustering, hierarchical clustering, Dimensionality Reduction: Principal Component Analysis (PCA), Application of Unsupervised Learning.	**08**	**CO1 CO2 CO5**
IV	**Neural Networks and Deep Learning** History and evolution of neural networks, key concepts: neurons, layers, and activation functions, Biological Inspiration: Neurons and synapses in the human brain, comparison between biological and artificial neural networks, basics of Artificial Neurons, perceptron and their mathematical modelling, Activation functions: sigmoid, tanh, ReLU, and others, Single-Layer Networks: Perceptron learning algorithm, Limitations of single-layer networks, Multi-Layer Perceptrons (MLPs), Structure and forward propagation, Backpropagation algorithm, Gradient descent and optimization techniques, Advanced Architectures: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks, Training Neural Networks: Loss Functions (Mean squared error, cross-entropy loss, and other common loss functions) Optimization Algorithms (Stochastic gradient descent (SGD) and variants (Momentum, RMSprop, Adam)), Regularization Techniques, Hyperparameter Tuning	**12**	**CO3 CO5**
V	**Reinforcement Learning** Introduction to Reinforcement Learning: Key concepts, rewards, policy, value functions, Algorithms: Q-learning, Deep Q-Networks (DQN).	**06**	**CO4 CO5**
	Total Hours	**42**	

Essential Readings

1. "Artificial Intelligence: A Modern Approach", by Stuart Russell and Peter Norvig, 4th Edition, Pearson, 2022.
2. Introduction to Machine Learning, by E. Alpaydin, Publisher: MIT Press, Edition, 2nd Edition, 2009.
3. "Deep Learning", by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016.

Supplementary Readings

1. "Pattern Recognition and Machine Learning" by Christopher Bishop, Springer, 2016.
2. "Introduction to Machine Learning with Python: A Guide for Data Scientists", by Andreas C. Müller and Sarah Guido, Shroff/O'Reilly; 1st Edition, 2016.
3. "Reinforcement Learning: An Introduction", by Richard S. Sutton and Andrew G. Barto, 2nd Edition, MIT Press, 2018.

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CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE468	**Advanced Robotics**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To introduce the basic concepts and mathematical preliminaries of robots**	Course Outcomes	EE468.1	**Able to acquire knowledge about basic concepts and mathematical preliminaries of robots and their applications.**	Knowledge Application
	To develop the skill to kinematics of serial, parallel, and hybrid manipulators		EE468.2	**Able to acquire knowledge about kinematics of serial, parallel, and hybrid manipulators and their applications.**	Knowledge Application
	To discuss about the solving approach of equations of motion using the Lagrangian formulation		EE468.3	**Able to design and justify the choice of appropriate control scheme for well-known industrial situations and design the controller to meet the requirement.**	Design Justify
	To develop the skill to control of robots, basic concepts in linear and nonlinear controls		EE468.4	**Able to design linear and nonlinear controls of robots.**	Design
	To introduce advanced topics in robotics such as modelling and analysis of wheeled mobile robots		EE468.5	**Able to understand and explain about the wheeled mobile robots.**	Understand Explain

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE468.1	**3**	**3**	**2**	**1**	**2**	**2**			**2**			**2**	**3**	**2**	**2**
EE468.2	**3**	**3**	**2**	**1**	**1**	**2**			**2**			**1**	**2**	**2**	**2**
EE468.3	**2**	**3**	**3**	**1**	**2**	**2**	**2**					**2**	**2**	**3**	**3**
EE468.4	**3**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**2**	**3**	**3**
EE468.5	**2**	**2**	**3**	**2**	**2**	**2**	**3**		**2**			**1**	**3**	**3**	**3**
EE468	**2.6**	**2.6**	**2.6**	**1.6**	**1.8**	**2**	**2.67**		**2**			**1.6**	**2.4**	**2.6**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Basic Concepts and Mathematical Preliminaries** Introduction, Types and Classification of Robots, Main Elements of a Robot, Modelling and Analysis of Robots, Mathematical Preliminaries, Homogeneous Transformations, Elements of robot Joints, Elements of robots-Links, Examples of D-H parameters and Link transformation matrices	**08**	**CO1**
II	**Kinematics of Robots** Introduction, Direct Kinematics of Serial Robots, Inverse Kinematics of Serial Robots, Elimination Theory & Solution of Non-linear Equations, Inverse Kinematics of a General 6R Robot, Loop-closure Equations, Direct Kinematics of Parallel Manipulators, Mobility of Parallel Manipulators, Inverse Kinematics of Parallel Manipulators, Direct Kinematics of Stewart Platform Manipulators, Applications of Parallel Robots	**09**	**CO2**
III	**Dynamics of Robots** Linear and Angular Velocity of Links, Serial Manipulator Jacobian Matrix, Parallel Manipulator Jacobian Matrix, Singularities in Serial and Parallel Manipulators, Statics of Serial and Parallel Manipulators, Lagrangian formulation, Examples of Equations of Motion, Inverse Dynamics & Simulation of Equations of Motion, Recursive Formulations of Dynamics of Manipulators	**09**	**CO3**
IV	**Linear and Nonlinear Controls** Motion planning, Control of a single link, Control of a multi-link serial manipulator, Control of a multi-link manipulator, Control of constrained and parallel manipulator, Cartesian control of serial manipulators, Force control of manipulators, Hybrid position/force control of manipulators, Advanced topics in non-linear control of manipulators	**09**	**CO4**
V	**Wheeled Mobile Robots (WMR)** Wheeled Mobile Robots (WMR) on Flat Terrain, Wheeled Mobile Robots (WMR) on Uneven Terrain, Kinematics and Dynamics of WMR on Uneven Terrain	**07**	**CO5**
	Total Hours	**42**	

Essential Readings

1. John J. Craig, "Introduction to Robotics", Global Edition, Pearson Education, 2021.
2. S. B. Niku, "An Introduction to Robotics Analysis, Systems, Applications", John Wiley & Sons, 2019.
3. Mike Wilson, "Implementation of Robotic Systems", Elsevier, 2014.

Supplementary Readings

1. J. J. Craig, "Introduction to Robotics: Mechanics and Control", Prentice Hall, 2013.
2. M. Mihelj et al., "Robotics", 2nd Edition, Springer, 2019

	National Institute of Technology Meghalaya An Institute of National Importance		MAPPING & EVALUATION SCHEME
Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering**	Semester	**VIII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C		MID	END	Total
EE482	**Major Project-2**	**0**	**0**	**22**	**11**		**30/100**	**70/100**	**100**

			COs	**Statement**
		After the completion of the course, the student should be able to:		
Course Objectives	**To introduce the basic concepts for preparing proposal on engineering and technology**	**Course Outcomes**	EE482.1	**Use critical and creative thinking to prepare proposal on engineering and technology**
	To teach the use modern engineering tools model, fundamental knowledge, and skills to develop methodology or prototype		EE482.2	**Design the system components and use the appropriate modern engineering tools**
	To develop skills to prepare and present the technical report and present via power point presentation		EE482.3	**Apply fundamental knowledge and skills to develop methodology or prototype as a team**
			EE482.4	**Incorporate the suggestions made to improve the project quality for societal and environmental contexts**
			EE482.5	**Demonstrate the project and prepare technical report as a team**

COs	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE482.1	1	3	3		3		3	2	3	3	3	3	3	3	2
EE482.2	3	3	3		2		3	3	2	3	3	2	2	3	3
EE482.3	2	1	1	3	1	2	1				2	3	2	3	3
EE482.4	3			3	2	3	2			2	1	2	1	2	1
EE482.5	1	1	1		1	2	3	3	2	3	2	2	2	2	1
Avg. EE482	**2.00**	**2.00**	**2.00**	**3.00**	**1.80**	**2.33**	**2.40**	**2.67**	**2.33**	**2.75**	**2.20**	**2.40**	**2.00**	**2.60**	**2.00**

Mapping of COs with Knowledge Level (KL)	
EE482.1	K3: Applying
EE482.2	K3: Applying; K4 : Analysing
EE482.3	K4: Analysing; K5 : Evaluating
EE482.4	K6: Creating
EE482.5	K3: Applying

Project Evaluation Scheme (MID/END)

Items	**Project Work (40)**			**Presentation (30)**			**Report (30)**			**Total (100)**	**Weightage**
	Literature Review and Problem Statement (20%) [08]	Execution (40%) [16]	Delivery of Objectives (40%) [16]	Skill (20%) [6]	Technical Interaction (60%) [18]	Quality of PPT (20%) [6]	Technical Content (60%) [18]	Discussion of the Results (20%) [6]	Quality of Report (20%) [6]	(100)	
Course Outcome	EE482.1	EE482.2 EE482.3	EE482.3 EE482.4	EE482.3	EE482.2 EE482.3 EE482.4	EE482.5	EE482.2 EE482.3 EE482.5	EE482.3 EE482.4	EE482.5		
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
Mid Term										Out of 100	30%
Supervisor										Out of 100	50%
Evaluating Member 1										Out of 100	25%
Evaluating Member 2										Out of 100	25%
End term										Out of 100	70%
Total											100