

Course Curriculum (in light of NEP 2020) for B. Tech.  
In  
Electrical Engineering

(For students admitted in 2025-26 onwards)



National Institute of Technology Arunachal Pradesh  
P.O.: Jote, Dist.: Papumpare,  
Arunachal Pradesh, Pin–791113  
[www.nitap.ac.in](http://www.nitap.ac.in)

Semesters	1	2	3	4	5	6	7	8	
Minimum Credits	20	40	60	84	100	125	140	160-172	
Multiple Entry	ENTRY		ENTRY		ENTRY		ENTRY		
Student Support Programs	Intensive Orientation	Finishing School	Bridge Course	Finishing School	Bridge Course	Finishing School	Bridge Course	Finishing School	Finishing School
Degree/Certification		Certificate		Diploma		B.Sc. Degree		B. Tech	B. Tech Honors
Multiple Exit Points		EXIT		EXIT		EXIT		EXIT	EXIT

Description	Details	Total Credits	Comments	Exit Degree			
Mathematics + Science + Humanities + Arts	SMASH	26	Science+ Mathematics + Arts + Social Science + Humanities (SMASH) Basket	Eligible for Diploma in	E l i g i b l e f o r B . S c i e n c e E n g i n e e r i n g D e g r e e w i t h M a j o r i n	-	Eligible for B. Tech. With Honours Degree (4 Years) with Major in
Major	MA1	50	Major for 2-year Diploma				
Project and Internship	AP1	6	If opting for 2-year course				
Electives	E1	3	If opting for 2-year course				
Total (D)	SMASH + MA1 + AP1 + E1	85	Mandatory Credits for 2 Year Course				
Humanities	SMASH	3	Science+ Mathematics + Arts + Social Science + Humanities (SMASH) Basket				
Major	MA2	MA1+14 = 64	Major Basket - 1				
Project and Internship	AP2	AP1+5 =10					
Electives	E2	E1+19= 22	Electives				
<b>Total (B1)</b>	SMASH + MA2 + AP2 + E2	<b>126</b>	Mandatory Credits for 3 Year Course				
/ Elective	MA3	27	Electives				
Project & Internship	AP3	7					
<b>Total (B2)</b>	SMASH + MA2+MA3 + AP2 + AP3+E2	<b>160</b>	Mandatory Credits for 4 Year Course				

Honours*	Theory	12	Additional Subjects	
<b>Total (B3)</b>	Total	<b>172</b>		

## Curriculum

### Semester wise Credit point distribution

Sl. No.	Year	Credit Point	
		ODD	EVEN
1	First	20	22
2	Second	22	21
3	Third	20	21
4	Fourth	22	12
<b>Total Credit Point</b>		<b>84</b>	<b>76</b>
		<b>160</b>	

Year	SMASH	Project	Major	Electives	Open Electives	Total	Cumulative Credit	Exit Degrees
1st	21	2	19	0	0	42	42	
2nd	5	4	31	3	0	43	<b>85</b>	<b>Diploma</b>
3rd	3	5	14	16/22	3	41/47	<b>126/132</b>	<b>BS (Engg.)</b>
4th	0	7	0	27/33	0	34/40	<b>160/172*</b>	<b>B.Tech</b>
<b>Total</b>	<b>29</b>	<b>18</b>	<b>64</b>	<b>46/58</b>	<b>3</b>	<b>160/172*</b>		-

- With 172 Credit Student will get B. Tech with Hons.

Semester Wise Break-up for credit requirements							
1st Semester		2nd Semester		3rd Semester		4th Semester	
Structure		Structure		Structure		Structure	
Course Category	Credits	Course Category	Credits	Course Category	Credits	Course Category	Credits
SMASH	13	SMASH	8	SMASH	5	SMASH	0
MAJOR	7	MAJOR	12	MAJOR	14	MAJOR	20

AP01	0	AP01	2	AP01	1	AP01	3
						ELECTIVE	0
<b>Total</b>	<b>20</b>	<b>Total</b>	<b>22</b>	<b>Total</b>	<b>20</b>	<b>Total</b>	<b>23</b>

Semester Wise Break-up for credit requirements							
5 <sup>th</sup> Semester		6 <sup>th</sup> Semester		7 <sup>th</sup> Semester		8 <sup>th</sup> Semester	
Structure		Structure		Structure		Structure	
Course Category	Credits	Course Category	Credits	Course Category	Credits	Course Category	Credits
SMASH	3	SMASH	0	SMASH	0	SMASH	0
MAJOR	12	MAJOR	2	MAJOR	0	MAJOR	0
AP02	2	AP02	3	AP03	4	AP03	3
OPEN ELECTIVE	3	ELECTIVE	16	ELECTIVE	15	ELECTIVE	12
<b>Total</b>	<b>20</b>	<b>Total</b>	<b>21</b>	<b>Total</b>	<b>19</b>	<b>Total</b>	<b>15</b>

Semester - I						
Sl No	Course Code	Course Title	L	T	P	C
1	BS-1101	SM01-SC1 - Engineering Mathematics-I	2	0	0	2
2	BS-1102	SM02-SC2 - Engineering Chemistry	2	0	0	2
3	BS-1103	SM03-SC3 - Engineering Physics	2	0	0	2
4	EC-1101	MAJOR-01 - DSC1 – Digital Logic Design	3	0	0	3
5	MH-1101	SM-04 - SECC1- Communication Skill	2	0	0	2
6	EE-1101	SM-05 - ESA2- Basic of Electrical and Electronics Engineering	2	0	0	2
7	CS-1102	MAJOR-02 - ESA3- Coding Laboratory	0	1	2	2
8	EE-1102	SM-06 - ESA4- Basic of Electrical and Electronics Engineering Laboratory	0	0	2	1
9	BS-1104	SM-07 - SC4- Engineering Physics Laboratory	0	0	2	1
10	ME-1102	MAJOR-03 -ESA5- Engineering Drawing	0	0	2	1
11	EC-1102	MAJOR-04 -DSC2- Digital Logic Design Laboratory	0	0	2	1
12	MH-1102	SM-08 -SECC2- Language Laboratory	0	0	2	1
13	MH-1103	VAC1 - NSS/NCC/Yoga (Audit Pass)	0	0	0	0
Contact Hours			13	1	12	

Total Credits							<b>20</b>
<b>Semester - II</b>							
Sl No	Course Code	Course Title	L	T	P	C	
1	BS-1201	SM-9 -SC5- Engineering Mathematics-II	2	0	0	2	
2	BT-1201	SM10-ESA1 - Biology for Engineers	2	0	0	2	
3	CS-1201	MAJOR-05 -ESA6- Programming and Data Structure	3	0	0	3	
4	CS-1202	MAJOR-06 -ESA7- AI in Engineering	2	0	0	2	
5	ME-1201	MAJOR-07 -ESA8- Engineering Mechanics	3	0	0	3	
6	EE-1201	MAJOR-08 -DSC3- Electromagnetic Field Theory	3	0	0	3	
7	MH-1201	SM-11 -ESA9- Law and Financial Aspects in Engineering	2	0	0	2	
8	EE-1202	AP1-01 -VAC2- Do It Yourself (DIY)/Industry Exposure	0	0	4	2	
9	BS-1202	SM-12 -SC6- Engineering Chemistry Laboratory	0	0	2	1	
10	CS-1205	MAJOR-8 -ESA10- Programming and Data Structure Laboratory	0	0	2	1	
11	MH-1202	SM-13 -VAC3- Indian Knowledge System (IKS)	0	0	2	1	
Contact Hours			17	0	10		
Total Credits							<b>22</b>
<b>Semester - III</b>							
Sl No	Course Code	Course Title	L	T	P	C	
1	BS-2101	SM-14-SC7 - Engineering Mathematics-III	3	0	0	3	
2	EC-2101	MAJOR-9-DSC4 - Microprocessor and Interfacing	3	0	0	3	
3	EC-3102	MAJOR-10-DSC5 - Signal and Systems	3	0	0	3	
4	EE-2101	MAJOR-11- DSC6 – Electrical Circuit Analysis	3	0	0	3	
5	EE-2102	MAJOR-12 - DSC7- Linear Control Systems	3	1	0	4	
6	MH-2101	SM-15 -ESA12- Introduction to Innovation and Creativity	2	0	0	2	
7	EE-2103	MAJOR-13- LAB1 - Electrical Circuit Analysis Laboratory	0	0	2	1	
8	EE-2104	MAJOR-14- LAB2 – Linear Control Systems Laboratory	0	0	2	1	
9	EC-2104	MAJOR 15- LAB3- Microprocessor Laboratory	0	0	2	1	
10	EE-2105	AP1-02-SECC4-Skill Development - 01	0	0	2	1	
Contact Hours			17	0	6		
Total Credits							<b>22</b>
<b>Semester - IV</b>							
Sl No	Course Code	Course Title	L	T	P	C	
1	EC-2201	ELECTIVE 01- DSE01- Analog Circuits	3	0	0	3	
2	EE-2201	MAJOR-16- DSC8- Power Electronics	3	0	0	3	
3	EE-2202	MAJOR-17- DSC 9 - Electric Machine-I	3	0	0	3	

4	EE-2203	MAJOR 18- DSC 10- Electrical and Electronics Measurement	3	0	0	3
5	EE-2204	MAJOR-19- DSC 11 – Power System-I	3	0	0	3
6	EE-2205	AP1-03-VAC4 MINOR PROJECT	0	0	4	2
7	EE-2206	MAJOR-20- LAB4 - Power Electronics Laboratory	0	0	2	1
8	EE-2207	MAJOR-21- LAB5 - Power System-I Laboratory	0	0	2	1
9	EE-2208	MAJOR-22- LAB6 - Electric Machines-I Laboratory	0	0	2	1
10	EE-2209	AP1-04 SECC 5 Electrical and Electronics Measurement Laboratory (Skill Development- 02)	0	0	2	1
<b>Contact Hours</b>			<b>15</b>	<b>0</b>	<b>12</b>	
<b>Total Credits</b>						<b>21</b>
<b>Semester - V</b>						
<b>Sl No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	EE-3101	MAJOR-23- DSC12 - Electrical Machines - II	3	0	0	3
2	EE-3102	MAJOR-24- DSC13 - Power System– II	3	0	0	3
3	EE-3103	MAJOR-25- DSC14 – Electrical Drives	3	0	0	3
4	EE-310X	OE1- Fundamentals of Power Electronics	3	0	0	3
5	MH-3101	SM 16- SECC 6- Entrepreneur essential and early stage start up	3	0	0	3
6	EE-3104	AP2-01- AECC1 - Internship-I	0	0	2	1
7	EE-3105	MAJOR-26- LAB7 - Electrical Machines – II Laboratory	0	0	2	1
8	EE-3106	MAJOR-27- LAB8 – Power Systems II Laboratory	0	0	2	1
9	EE-3107	MAJOR-28- LAB9 - Electrical Drives Laboratory	0	0	2	1
10	EE-3108	AP2-02 SECC7 Skill Development - 03	0	0	2	1
11	EE-311H	Advanced Power Electronics	3	0	0	3*
<b>Contact Hours</b>			<b>15</b>	<b>0</b>	<b>10</b>	
• Credit for B. Tech (Hons)						
<b>Total Credits</b>						<b>20</b>
<b>Semester - VI</b>						
<b>Sl No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	EE-3201	ELECTIVE 02-DSE02 - Switchgear and Protection	3	0	0	3
2	EE-321A/ EE-321B	ELECTIVE 03-DSE03 - Fundamentals of FACTs ELECTIVE 04-DSE04- Energy Storage Systems and Battery Management	3	0	0	3
3	EE- 320X	OE2- Fundamentals of Power Systems	3	0	0	3
4	EE-322A / EE-322B	ELECTIVE-05-DSE05 - Fundamentals of Solar PV Systems ELECTIVE-06-DSE06- Power Plant Engineering	3	0	0	3

5	EE-323A /	ELECTIVE-07-DSE07- Electrical Drives and Motor Control	3	0	0	3
6	EE-323B	ELECTIVE-08-DSE8- Power Electronics and Grid Integration of Renewable Energy sources				
7	EE-3202	AP2-03- VAC5 - Minor Project	0	0	4	2
8	EE-3203	MAJOR-29 – LAB10 - Switchgear and Protection Laboratory	0	0	2	1
9	EE-3204	MAJOR-30- LAB11 - Solar PV Laboratory	0	0	2	1
10	EE-3205	ELECTIVE-09 - LAB12 - Non-Conventional Energy Systems Laboratory	0	0	2	1
11	EE-3206	AP2-04 SECC8 Skill Development - 04	0	0	2	1
12	EE-321H	Modern Optimization Techniques for Electrical Power Systems	3	0	0	3*
<b>Contact Hours</b>			<b>15</b>	<b>0</b>	<b>12</b>	
<b>*Credit for B. Tech (Hons)</b>						
<b>Total Credits</b>						<b>21</b>
<b>Semester - VII</b>						
<b>Sl No</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	EE-4101	ELECTIVE-10-DSE9 - High Voltage Engineering	3	0	0	3
2	EE-411A / EE-411B/ EE-411C	ELECTIVE-11-DSE10 - Power System Restructuring and Deregulation ELECTIVE-12-DSE11 - Power Electronics for EV applications ELECTIVE-13-DSE12- Energy Policy, Economics and Environmental Impacts	3	0	0	3
3	EE-412A / EE-412B/ EE-412C	ELECTIVE-14- DSE13 - Principles of Energy Conversion Systems ELECTIVE-15- DSE14- Special Electrical Machines ELECTIVE-16- DSE15- EV Charging Infrastructure and Smart Grid Integration	3	0	0	3
4	EE-413A / EE-413B / EE-413C/	ELECTIVE-17- DSE16- Smart Grids ELECTIVE-18- DSE17 - Robotics and Control ELECTIVE-19- DSE18 - Embedded System Design	3	0	0	3
5	EE-414A/ EE-414B	ELECTIVE-20- DSE19 - Smart and Green Building Energy Systems ELECTIVE-21- DSE20- EV Design and Prototyping	3	0	0	3
6	EE-415A/ EE-415B	ELECTIVE-22- DSE21- Industrial Electrical Systems and Safety ELECTIVE-23 - DSE22 – Load Forecasting	3	0	0	3
7	EE-4102	AP2-05 - AECC2 - Internship-II	0	0	2	1
8	EE-4103	AP2-06- VAC6 - Major Project-I	0	0	6	3

9	EE-410H	Non-linear Control Systems	3	0	0	3*
Contact Hours			15	0	10	
*Credit for B. Tech (Hons)						
Total Credits						22
<b>Semester - VIII</b>						
Sl No	Course Code	Course Title	L	T	P	C
1	EE-421A/	ELECTIVE-24- DSE23 - Modern Control Systems /SWAYAM*	3	0	0	3
2	EE-423OA/	ELECTIVE-25- DSE 24– SWAYAM Course	3	0	0	3
3	EE-424OA/	ELECTIVE-26- DSE25 – SWAYAM Course	3	0	0	3
4	EE-4201	AP2-07 VAC7 - Major Project-II	0	0	6	3
5	EE-420H	Sensors and Transducers	3	0	0	3*
Contact Hours			15	0	6	
*Credit for B. Tech (Hons)						
Total Credits						12

\* Students who will go for Internship required for joining a job may opt for equivalent SWAYAM Course

<b>OPEN ELECTIVES FOR OTHER DEPARTMENTS</b>				
<b>For Minor Degree in Electrical Engineering</b>				
SL. No	Course Code	Course Title	L-T-P	Credits
1	EE-210X	Fundamentals of Circuit Analysis	3-0-0	3
2	EE -220X	Fundamentals of Linear control systems	3-0-0	3
3	EE -310X	Fundamentals of Power Electronics	3-0-0	3
4	EE -320X	Fundamentals of Power Systems	3-0-0	3
5	EE -410X	Fundamentals of Electric Machines	3-0-0	3
6	EE -420X	Project on Minor Degree		5
<b>Total</b>				20



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**NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH**  
 (शिक्षामंत्रालय, भारत सरकारकेतहत राष्ट्रीय महत्वका संस्थान)  
 (Institute of National Importance under Ministry of Education, Govt. of India)

**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering (SM-05-ESA2)	<b>Semester</b>	I

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-1101	Basic of Electrical and Electronics	2	0	0	2	20	30	50	100	
<b>Course Objectives</b>	1. Understand the basic concepts and laws of electrical circuits. 2. Apply Kirchhoff's and network theorems for circuit analysis. 3. Explain AC fundamentals and power calculations. 4. Understand the working of semiconductor devices like diodes and transistors. 5. Analyze and design simple rectifier and basic electronic circuits.	<b>Course Outcomes</b>	CO1	Explain basic electrical quantities, circuit elements, and their relationships.					Understand	
			CO2	Apply Kirchhoff's laws and network theorems to analyze circuits					Apply	
			CO3	Analyze AC circuit parameters such as impedance, power, and phase.					Analyze	
			CO4	Describe the characteristics and operation of diodes and transistors.					Understand	
			CO5	Design and evaluate simple rectifier and amplifier circuits.					Evaluate	

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	CO1	3	2										1			
2	CO2	3	3		2											
3	CO3	3	3	2	2								1			
4	CO4	2	2			2							1			
5	CO5	2	2	3		2							1			
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	Basic Electrical Concepts: Current, voltage, resistance, power, energy; Ohm's law; series and parallel circuits; Kirchhoff's Current and Voltage Laws (KCL & KVL).	5	<b>CO1</b>
<b>II</b>	Network Theorems: Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem – simple numerical problems.	5	<b>CO2</b>
<b>III</b>	AC Fundamentals: Sinusoidal waveforms, RMS and average values, phase and frequency, phasor representation, simple RLC series and parallel circuits, power factor.	6	<b>CO3</b>
<b>IV</b>	Semiconductor Devices: Semiconductor basics; PN junction diode characteristics; Zener diode; LED; BJT – construction, operation, input-output characteristics.	7	<b>CO4</b>
<b>V</b>	Rectifiers and Basic Circuits: Half-wave, full-wave, and bridge rectifiers; capacitor filters; Zener voltage regulator; transistor as a switch and amplifier; introduction to logic gates (AND, OR, NOT).	7	<b>CO5</b>
<b>Total Hours</b>		<b>30</b>	

**Text Books:**

1. V.K. Mehta & Rohit Mehta, *Principles of Electrical Engineering*, S. Chand.
2. S.K. Bhattacharya, *Basic Electrical and Electronics Engineering*, Pearson.
3. R.S. Sedha, *Applied Electronics*, S. Chand.

**Reference Books:**

1. M.S. Naidu & S. Kamakshiah, *Introduction to Electrical Engineering*, Tata McGraw-Hill.
2. Boylestad & Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	I

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-1102	Basic of Electrical and Electronics Laboratory (SM-06-ESA4-LAB)	0	0	2	1	50	0	50	100	
<b>Course Objectives</b>	1. Verify fundamental laws and theorems of electrical circuits. 2. Measure electrical parameters in AC and DC circuits. 3. Understand the operation of semiconductor devices. 4. Construct and test rectifier and voltage regulator circuits.	<b>Course Outcomes</b>	<b>CO1</b>	Verify Ohm's and Kirchhoff's laws experimentally.					Measure, Verify	
			<b>CO2</b>	Apply and validate network theorems in DC circuits.					Demonstrate, Compare	
			<b>CO3</b>	Measure voltage, current, and power in AC circuits.					Analyze, Measure	
			<b>CO4</b>	Analyze characteristics of diodes and transistors.					Plot, Interpret, Examine	
			<b>CO5</b>	Construct and evaluate rectifier and voltage regulator circuits.					Construct, Test, Evaluate	

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	CO1	3	2		1					1						
2	CO2	3	3		2					1						
3	CO3	2	3	1	2	2				1						
4	CO4	2	2	1	2	3										
5	CO5	2	2	3	2	3							1			
<b>(Average)</b>													1			

**SYLLABUS**

No.	Content	Hours	COs
I	Verification of <b>Ohm's Law</b> and determination of resistance using voltmeter-ammeter method.	2	CO1
II	Verification of <b>Kirchhoff's Current and Voltage Laws (KCL &amp; KVL)</b> .	2	CO1
III	Verification of <b>Thevenin's and Norton's Theorems</b> in DC circuits.	2	CO2
IV	Measurement of <b>power and power factor</b> in a single-phase RLC circuit.	2	CO3
V	Study and plotting of <b>V-I characteristics of a PN Junction Diode</b> .	2	CO4
VI	Study of <b>Zener Diode</b> as a voltage regulator.	2	CO5
VII	Construction and observation of <b>Full-Wave Bridge Rectifier</b> with and without capacitor filter.	2	CO5
VIII	Study of <b>Transistor characteristics (CE configuration)</b> .	2	CO6
<b>Total Hours</b>		<b>16</b>	

**Text Books:**

1. R. S. Sedha, *Applied Electronics*, S. Chand & Company Ltd.
2. V. K. Mehta and Rohit Mehta, *Principles of Electrical Engineering*, S. Chand & Company Ltd.
3. B. L. Theraja and A. K. Theraja, *Basic Electrical Engineering*, S. Chand & Company Ltd.

**Reference Books:**

1. M. L. Soni, J. P. Gupta, and U. S. Bhatnagar, *A Textbook of Electrical Technology (Vol. I & II)*, Dhanpat Rai & Co.
2. Boylestad and Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education.
3. Millman and Halkias, *Electronic Devices and Circuits*, Tata McGraw-Hill.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	II

Course Code	Course Name (MAJOR-08-DSC3)	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-1201	Electromagnetic Field Theory	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Introduce fundamental concepts of electric and magnetic fields. 2. Develop mathematical models for static and dynamic electromagnetic fields. 3. Analyse the behaviour of fields in different media and boundary conditions. 4. Apply Maxwell's equations to solve real-world electromagnetic problems. 5. Explore applications in transmission lines, waveguides, and antennas.	<b>Course Outcomes</b>	<b>CO1</b>	Understand vector calculus and coordinate systems for electromagnetic field analysis.						Understanding/Comprehension
			<b>CO2</b>	Apply mathematical techniques to represent signals and analyse linear time-invariant (LTI) systems.						Application/Analysis
			<b>CO3</b>	Utilize Ampere's Law and Biot-Savart Law for magnetostatics.						Application/Synthesis
			<b>CO4</b>	Analyze time-varying fields using Faraday's Law and Maxwell's Equations.						Analysis/Evaluation
			<b>CO5</b>	Examine electromagnetic wave propagation and transmission line theory.						Evaluation

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	CO1	3	2		1								1			
2	CO2	3	3	1	2	2							1			
3	CO3	3	3	1	2	3							1			
4	CO4	3	3	2	3	3							2			
5	CO5	3	3	2	3	3				1			2			
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Vector Analysis and Coordinate Systems:</b> Cartesian, cylindrical, and spherical coordinates, gradient, divergence, curl, Stokes' Theorem and Divergence Theorem.	8	<b>CO1</b>
<b>II</b>	<b>Electrostatics:</b> Coulomb's Law, Gauss's Law, electric field intensity, potential, capacitance, and energy storage.	8	<b>CO2</b>
<b>III</b>	<b>Magnetostatics:</b> Biot-Savart Law, Ampere's Circuital Law, magnetic flux density, vector potential, inductance, and energy in magnetic fields.	9	<b>CO3</b>
<b>IV</b>	<b>Time-Varying Electromagnetic Fields:</b> Faraday's Law, displacement current, Maxwell's Equations, boundary conditions.	7	<b>CO4</b>
<b>V</b>	<b>Electromagnetic Wave Propagation:</b> Wave equation, plane waves in free space and dielectrics, Poynting theorem, polarization.	7	<b>CO5</b>
<b>VI</b>	<b>Transmission Lines and Waveguides:</b> Transmission line equations, characteristic impedance, Smith chart, wave propagation in rectangular waveguides.	6	<b>CO5</b>
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. W.H. Hayt, J.A. Buck, *Engineering Electromagnetics*, McGraw Hill, 2011.
2. Matthew N.O. Sadiku, *Elements of Electromagnetics*, Oxford University Press, 2018.
3. D.K. Cheng, *Field and Wave Electromagnetics*, Pearson, 2013.

**Reference Books:**

1. J.D. Kraus, *Electromagnetics*, McGraw Hill, 1991.
2. F.T. Ulaby, *Fundamentals of Applied Electromagnetics*, Pearson, 2010.
3. R. K. Shevgaonkar, *Electromagnetic Waves*, McGraw Hill, 2005..



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	III

Course Code	Course Name (MAJOR-08-DSC3)	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-2101	Electrical Circuit Analysis	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Develop an understanding of fundamental circuit laws and network theorems. 2. Analyse AC and DC circuits using different methods. 3. Understand transient and steady-state responses of electrical circuits. 4. Introduce Laplace transform techniques for circuit analysis. 5. Apply two-port network theory and resonance concepts.	<b>Course Outcomes</b>	CO1	Understand the basic circuit laws, network theorems, and analysis techniques.						Understanding/Comprehension
			CO2	Analyze DC and AC circuits using mesh, nodal, and network theorems.						Application/Analysis
			CO3	Examine transient and steady-state responses of RL, RC, and RLC circuits.						Application/Synthesis
			CO4	Evaluate two-port network parameters and their applications.						Analysis/Evaluation
			CO5	Apply Laplace transform techniques to solve circuit equations.						Evaluation

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	3	1	1	1							1			
2	CO2	3	3	2	2	2							1			
3	CO3	3	3	2	2	2							1			
4	CO4	3	3	3	2	3				1			2			
5	CO5	3	3	2	2	3				1			2			
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Basic Concepts and Circuit Laws:</b> Ohm's Law, Kirchoff's Laws, series and parallel circuits, star-delta transformation, source transformation.	7	CO1
II	<b>Network Theorems:</b> Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem, Millman's theorem.	8	CO2
III	<b>AC Circuit Analysis:</b> Phasor representation, impedance, admittance, power and power factor, resonance in series and parallel circuits, Q-factor.	9	CO2
IV	<b>Transient and Steady-State Analysis:</b> First and second-order circuits (RL, RC, RLC), step response, forced response, time constants.	7	CO3
V	<b>Laplace Transform and Applications:</b> Laplace transform of circuit elements, inverse transform, transfer function, frequency response analysis.	6	CO4
VI	<b>Two-Port Networks:</b> Z, Y, h, and transmission parameters, interconnections of two-port networks, reciprocity and symmetry properties. Introduction to Filters, Low Pass Filters (LPF), High Pass Filters (HPF), Band Pass Filters (BPF), Applications of Filters	8	CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. A. Chakrabarti, *Circuit Theory (Analysis and Synthesis)*, Dhanpat Rai Publications, 2018.
2. B.L. Theraja and A.K. Theraja Volume I: Basic Electrical Engineering, S. Chand & Company Ltd.
3. William H. Hayt, Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw Hill, 2012.
4. M.E. Van Valkenburg, *Network Analysis*, Prentice Hall, 2010.

**Reference Books:**

1. Charles K. Alexander, Matthew N.O. Sadiku, *Fundamentals of Electric Circuits*, McGraw Hill, 2016.
2. John D. Ryder, *Networks, Lines, and Fields*, Prentice Hall, 2013.
3. Franklin F. Kuo, *Network Analysis and Synthesis*, Wiley, 2006.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	III

Course Code	Course Name (MAJOR-08-DSC3)	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	

EE-220X	Linear Control Systems	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To develop the ability to model and analyse linear time-invariant (LTI) control systems using mathematical representations such as differential equations, transfer functions, block diagrams, and state-space forms.</li> <li>To enable students to evaluate system performance in time and frequency domains and interpret system behavior using standard performance indices, stability criteria, and response characteristics.</li> <li>To impart skills in designing and tuning controllers and compensators (PID, lead, lag, and lead-lag) using classical methods such as root locus and frequency-response techniques.</li> <li>To introduce modern control concepts including state-space modelling, controllability, observability, and state-feedback design for improved system performance.</li> </ol>	<b>Course Outcomes</b>	<b>CO1</b>	Students will be able to model and represent linear time-invariant systems using transfer functions, block diagrams, and state-space methods.	Understanding/Comprehension					
			<b>CO2</b>	Students will be able to analyze the time-domain performance of first- and second-order systems and evaluate stability using classical criteria.	Application/Analysis					
			<b>CO3</b>	Students will be able to interpret and assess frequency-domain characteristics using Bode plots, Nyquist plots, and gain/phase margins.	Application/Synthesis					
			<b>CO4</b>	Students will be able to design and tune controllers and compensators (PID, lead, lag, and lead-lag) to meet specified performance requirements.	Analysis/Evaluation					
			<b>CO5</b>	Students will be able to apply state-space concepts—including controllability, observability, and state feedback—to analyze and improve system performance.	Evaluation					

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	CO1	3	3	1	1	1							1			
2	CO2	3	3	2	2	2							1			
3	CO3	3	3	2	2	2							1			
4	CO4	3	3	3	2	3				1			2			
5	CO5	3	3	2	2	3				1			2			
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	Introduction to control systems, open-loop and closed-loop systems, feedback principles, mathematical modeling of mechanical/electrical systems, block diagrams, signal-flow graphs, Mason's gain formula.	7	<b>CO1</b>
<b>II</b>	Time-domain analysis, standard test signals, transient and steady-state response, first- and second-order system responses, time-domain specifications, steady-state errors, error constants, Routh-Hurwitz stability criterion.	8	<b>CO2</b>
<b>III</b>	Frequency-domain analysis, frequency response concepts, Bode plots, gain and phase margins, bandwidth, Nyquist criterion, polar plots, Nichols chart, stability analysis.	9	<b>CO2</b>
<b>IV</b>	Control system components, potentiometers, tachogenerators, synchros, actuators (DC/AC servomotors, stepper motors), sensors, analog/digital controllers, state-variable modeling, transfer function-state space conversion.	7	<b>CO3</b>
<b>V</b>	Root locus concepts, rules and construction, stability determination, effect of poles and zeros, controller design using root locus, PID/PI/PD tuning, lead, lag, and lead-lag compensator design.	6	<b>CO4</b>
<b>VI</b>	State-space representation, state variables, state transition matrix, solution of state equations, controllability, observability, canonical forms, state feedback (pole placement), introduction to observers.	8	<b>CO5</b>
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. K. Ogata, *Modern Control Engineering*, Prentice Hall
2. B. C. Kuo, *Automatic Control Systems*, Wiley
3. N. S. Nise, *Control Systems Engineering*, Wiley
4. I. J. Nagrath & M. Gopal, *Control Systems Engineering*, New Age International Publishers

**Reference Books:**

1. Richard C. Dorf & Robert H. Bishop, *Modern Control Systems*, Pearson
2. Gene F. Franklin, J. David Powell & Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, Pearson
3. Chi-Tsong Chen, *Linear System Theory and Design*, Oxford University Press
4. Graham C. Goodwin, Stefan F. Graebe & Mario E. Salgado, *Control System Design*, Pearson



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	III

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-2103	Electrical Circuit Analysis Laboratory (MAJOR-13-LAB1)	0	0	2	1	50	0	50	100	
<b>Course Objectives</b>	1. Develop practical skills in circuit design, testing, and analysis.	<b>Course Outcomes</b>	<b>CO1</b>	Understand and verify basic circuit laws and network theorems.					Understanding/Comprehension	
	2. Verify theoretical concepts of circuit laws and network theorems.		<b>CO2</b>	Perform DC and AC circuit analysis using different methods.					Application/Analysis	
	3. Analyse transient and steady-state responses of electrical circuits.		<b>CO3</b>	Examine transient and steady-state behaviour of RL, RC, and RLC circuits.					Application/Synthesis	
	4. Implement AC circuit analysis techniques and resonance studies.		<b>CO4</b>	Evaluate two-port network parameters and resonance characteristics.					Analysis/Evaluation	
	5. Apply simulation tools to study electrical circuit behaviour.		<b>CO5</b>	Use simulation tools for circuit analysis and validation.					Evaluation	

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	CO1	3	3	1	2					1			1			
2	CO2	3	3	2	2					1			1			
3	CO3	3	3	2	3					1			1			
4	CO4	3	3	2	3						1		2			
5	CO5	2	2	2	2					1	1		2			
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	Verification of Ohm's Law and Kirchhoff's Laws.	2	CO1
<b>II</b>	Thevenin's Theorem and Norton's Theorem verification.	2	CO1
<b>III</b>	Superposition Theorem and Maximum Power Transfer Theorem.	2	CO1, CO2
<b>IV</b>	Series and Parallel Resonance in AC Circuits.	2	CO2, CO4
<b>V</b>	Measurement Z parameter of Two-Port Network.	2	CO4
<b>VI</b>	Measurement ABCD parameter of Two-Port Network.	2	CO4
<b>VII</b>	Measurement h parameter of Two-Port Network.	2	CO4
<b>VIII</b>	Introduction to Circuit Simulation Tools (MATLAB, PSPICE, or Multisim).	2	CO5
<b>Total Hours</b>		<b>16</b>	

**Text Books:**

1. W.H. Hayt, J.A. Buck, *Engineering Electromagnetics*, McGraw Hill, 2011.
2. Matthew N.O. Sadiku, *Elements of Electromagnetics*, Oxford University Press, 2018.
3. D.K. Cheng, *Field and Wave Electromagnetics*, Pearson, 2013.

**Reference Books:**

1. J.D. Kraus, *Electromagnetics*, McGraw Hill, 1991.
2. F.T. Ulaby, *Fundamentals of Applied Electromagnetics*, Pearson, 2010.
3. R. K. Shevgaonkar, *Electromagnetic Waves*, McGraw Hill, 2005..



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	III

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-2104	Linear Control Systems Laboratory	0	0	2	1	50	0	50	100	
<b>Course Objectives</b>	1. To introduce the fundamentals of control systems and enable students to develop mathematical models of linear time-invariant (LTI) systems using transfer functions and state-space methods. 2. To provide analytical skills to evaluate system performance through time-domain and frequency-domain techniques, including stability assessment. 3. To develop the ability to design classical controllers and compensators such as PID, lead, lag, and lead-lag using root locus and frequency-response methods. 4. To familiarize students with modern control concepts including state-space analysis, controllability, observability, state feedback, and observer design.	<b>Course Outcomes</b>	<b>CO1</b>	Model LTI systems using transfer function and state-space representations.	Understanding/Comprehension					
			<b>CO2</b>	Analyze time-domain responses and determine system stability using classical criteria.	Application/Analysis					
			<b>CO3</b>	Interpret frequency-domain behavior using Bode, Nyquist, and other frequency-response plots.	Application/Synthesis					
			<b>CO4</b>	Design and tune controllers/compensators to meet given performance specifications.	Analysis/Evaluation					
			<b>CO5</b>	Apply state-space methods to evaluate controllability, observability, and design state-feedback controllers.	Evaluation					

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	CO1	3	3	1	2					1			1			
2	CO2	3	3	2	2					1			1			
3	CO3	3	3	2	3					1			1			
4	CO4	3	3	2	3						1		2			
5	CO5	2	2	2	2					1	1		2			
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	Create transfer function and state-space models of mechanical/electrical systems; analyze poles, zeros, and system behavior using MATLAB functions.	2	CO1
II	Obtain step, impulse, and ramp responses; extract time-domain specifications (rise time, settling time, overshoot, steady-state error) using MATLAB's stepinfo.	2	CO1
III	Develop MATLAB scripts to form the Routh array; determine system stability and analyze pole movement for parameter variations.	2	CO1, CO2
IV	Plot Bode diagrams using bode; compute gain margin, phase margin, crossover frequencies, and interpret frequency response characteristics.	2	CO2, CO4
V	Generate root locus using rlocus; design and test PI/PD/PID controllers or pole-zero additions to achieve desired performance.	2	CO4
VI	Use MATLAB's control design toolbox to design compensators; verify improvements in time and frequency domain behavior.	2	CO4
VII	Use MATLAB to solve state equations, compute the state transition matrix (expm), and simulate system responses using initial and lsim.	2	CO4
VIII	Design state-feedback controllers using place or acker; design a Luenberger observer; simulate closed-loop and observer-based control performance.	2	CO5
<b>Total Hours</b>		<b>16</b>	

**Text Books:**

1. K. Ogata, *Modern Control Engineering*, Prentice Hall
2. B. C. Kuo, *Automatic Control Systems*, Wiley
3. N. S. Nise, *Control Systems Engineering*, Wiley
4. I. J. Nagrath & M. Gopal, *Control Systems Engineering*, New Age International Publishers

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2. Gene F. Franklin, J. David Powell & Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, Pearson
3. Chi-Tsong Chen, *Linear System Theory and Design*, Oxford University Press
4. Graham C. Goodwin, Stefan F. Graebe & Mario E. Salgado, *Control System Design*, Pearson



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ई-मेल E-Mail: [nitarunachal@nitap.ac.in](mailto:nitarunachal@nitap.ac.in)/[registrarcell@nitap.ac.in](mailto:registrarcell@nitap.ac.in)  
वेबसाइट Website: [www.nitap.ac.in](http://www.nitap.ac.in), फोन Ph: 0360-2954549

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## Department of Electrical Engineering (Skill Development Course)

EE-2105

MATLAB & Simulink for Electrical Engineers

0 0 2: 1

### Technical Skills

- Reinforces Linear Control Systems, Signals & Systems, Power Systems, Machines.

Highly demanded in industry for modeling, simulation, and design.

Useful for internships, projects, and later courses like Power Electronics & Drives.

### Core Skills Gained:

System modeling and simulation

Control system design

Power electronics and electrical machine simulations

Data analysis and automation

Exposure to real-world engineering work-flows



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	

EE – 2201	Power Electronics	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To introduce the fundamental principles and switching behaviour of power semiconductor devices.</li> <li>To analyze and design converter circuits for AC–DC, DC–DC, DC–AC, and AC–AC power conversion.</li> <li>To understand the operation and control of rectifiers, choppers, inverters, and cycloconverters.</li> <li>To develop the ability to simulate converter systems and assess performance parameters.</li> <li>To expose students to practical and industrial applications of power electronics in drives, renewable energy systems, and power supplies.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain the structure, characteristics, and operation of power semiconductor devices.	Understanding / Comprehension					
			CO2	Analyze the operation and performance of controlled rectifiers, choppers, and inverters.	Apply / Analyze					
			CO3	Design and simulate basic converter circuits for different power conversion functions.	Apply / Evaluate					
			CO4	Evaluate performance parameters such as harmonics, efficiency, and voltage regulation.	Analyze / Evaluate					
			CO5	Apply power electronics principles in industrial, EV, and renewable applications.	Understand / Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Power Electronics:</b> Overview, applications, importance in modern systems; power flow and conversion principles; distinctions between electronics and power electronics. <b>Power Semiconductor Devices:</b> Diodes, SCRs, MOSFETs, IGBTs; static and dynamic characteristics; device ratings and selection; protection and thermal management.	13	CO1
			CO2
II	<b>AC–DC Converters (Phase Controlled Rectifiers):</b> Single-phase and three-phase half- and full-controlled converters; performance parameters—average output voltage, power factor, input current harmonics; operation with resistive and inductive loads; effect of source inductance; freewheeling diodes; converter control and overlap angle analysis.	8	CO2
			CO3
III	<b>DC–DC Converters (Choppers):</b> Step-down, step-up, buck–boost, Cuk, and SEPIC converters; switching and commutation principles; duty ratio control; PWM control strategies; continuous and discontinuous conduction modes; design equations and efficiency analysis; isolated converters (forward, flyback).	8	CO3
			CO4
IV	<b>DC–AC Converters (Inverters):</b> Single-phase and three-phase inverters: voltage and current source types; PWM methods—single-pulse, multiple-pulse, sinusoidal, and space vector PWM; harmonic analysis and reduction; voltage control of inverters; CSI and VSI-fed drives; unipolar switching and dead-time effects. <b>AC–AC Converters:</b> Single-phase and three-phase AC voltage controllers; integral cycle control; cycloconverters—principle, operation, and frequency control; matrix converters—concept, topology, and applications. <b>Applications and Simulations:</b> Applications in renewable energy, electric vehicles, and household devices; introduction to MATLAB/Simulink-based simulation of converters.	16	CO3
			CO4
			CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- M. H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, Pearson.
- N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
- P. S. Bimbhra, *Power Electronics*, Khanna Publishers.
- V. Subrahmanyam, *Power Electronics – Devices, Circuits and Industrial Applications*, New Age International.

**Reference Books:**

- B. K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
- R. Krishnan, *Electric Motor Drives: Modeling, Analysis, and Control*, Prentice Hall.
- Fang Lin Luo and Hong Ye, *Fundamentals of DC–DC Converters*, CRC Press.
- Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
- P. C. Sen, *Power Electronics*, Tata McGraw-Hill.



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<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 2202	Electrical Machines - I	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. acquire knowledge about the fundamental principles and classification of electromagnetic machines. 2. acquire knowledge about the constructional details and principle of operation of dc machines. 3. acquire knowledge about the working of dc machines as generators and motors. 4. acquire knowledge about the constructional details, principle of operation, testing and applications of transformers.	<b>Course Outcomes</b>	CO1	Able to understand the basic structure of various types of machines used like DC machines and Transformer.						Understanding/Comprehension	
			CO2	Able to illustrate the working principle and different types of DC machines.						Understanding/Comprehension	
			CO3	Able to illustrate the constructional features and different types of DC machines as generators and motors.						Identify/Knowledge/Remember	
			CO4	Able to illustrate the constructional features and different types of Transformers.						Understanding Analyzing	

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Magnetic fields and magnetic circuits Review of magnetic circuits:</b> MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines. Electromagnetic force and torque: B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples -galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency.	10	CO1 CO2 CO3
II	<b>DC machines:</b> Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.	10	CO2 CO3
III	<b>DC machine - motoring and generation:</b> Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.	10	CO3 CO4
IV	<b>Transformers:</b> Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.	15	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

**Reference Books:**

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 2203	Electrical and Electronics Measurement	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. introduce students to the principles and techniques of electrical and electronic measurements, focusing on the operation, calibration, and application of various measuring instruments. 2. equip students with the skills to perform accurate electrical measurements and interpret data using advanced tools and instruments in the lab environment. 3. develop an understanding of the importance of measurement uncertainty and error analysis in electrical and electronics measurements, ensuring high-quality results in practical applications.	<b>Course Outcomes</b>	CO1	Demonstrate the operation and application of various electrical and electronic measuring instruments, such as voltmeters, ammeters, oscilloscopes, and spectrum analyzers.	Understanding/Comprehension						
			CO2	Perform hands-on measurements on different electrical circuits, including AC/DC signals, and analyze the data for system performance evaluation.	Understanding/Comprehension						
			CO3	Analyze and minimize measurement errors and uncertainties using standard procedures and techniques to enhance the accuracy of measurements.	Identify/Knowledge/Remember						
			CO4	Apply measurement techniques to real-world problems in areas like signal processing, control systems, and communications, contributing to professional decision-making.	Understanding Analyzing						

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction- Basics of Measurements:</b> Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement, calibration of instruments. <b>Bridge Measurements:</b> AC bridges: Applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien's bridge, De Sauty's bridge, Shielding of bridges, Insulation testing, Ground resistance measurement, Varley and Murray loop test. <b>Measurement of Resistance:</b> Wheatstone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger.	10	CO1 CO2 CO3
II	<b>Electromechanical Indicating Instruments:</b> PMMC galvanometer, Ohmmeter, Electrodynamometer, moving iron meter, Rectifier and thermo-instruments, Comparison of various types of indicating instruments. <b>Extension of Instrument Ranges:</b> Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characteristics, Errors of CT and PT. Turns compensation, Illustrative examples, Silsbee's method of testing CT. <b>Magnetic measurements:</b> Introduction, measurement of flux/ flux density, magnetizing force and leakage factor. <b>Power and Energy Measurement:</b> Electrodynamometer type of wattmeter and power factor meter, Power in poly phase system: two wattmeter method, Single-phase induction and electronic energy meters.	10	CO2 CO3
III	<b>Instrument Transformers:</b> Current and Voltage transformers, Constructional features, Ratio and Phase angle errors. <b>Oscilloscopes:</b> - Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Delay lines, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes, Storage Oscilloscope, Sampling Oscilloscope. <b>Electronic Instruments:</b> Electronic multimeter, Digital voltmeters, General characteristics ramp type voltmeter, Quantization error, Digital frequency meter/Timer, Q meter and its applications, Distortion meter, Wavemeter and Spectrum Analyzer.	12	CO3 CO4
IV	<b>Display Devices:</b> - LED, LCD, Power quality analyzer, Applications of expert systems for power quality monitoring, Net Metering and data logger. <b>Digital Data Acquisition System:</b> Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems. IEEE488 GPIB Bus. <b>Recording Devices:</b> Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and XY recorders. Digital tape recording, Ultraviolet recorders. Electro Cardio Graph (ECG)	13	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Shawney A.K., "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, 2018
2. Kalsi H. S., "Electronic Instrumentation", Tata McGraw Hill, 2007.
3. Nakra C. & Chaudhary K.K., "Instrumentation Measurement and Analysis", Tata McGraw Hill, 2003.
4. Patranabis. D, "Sensors & Transducers", PHI, 2010

**Reference Books:**

1. Golding E. W. and Widdis F. C., "Electrical Measurements and Measuring Instruments", Pitman, 2003.

2. Helfrick A. D. and Cooper W. D., *“Modern Electronic Instrumentation and Measurement Techniques”*, Prentice Hall of India, 2007.
3. Bernard Oliver and John Cage., *“Electronic Measurements and Instrumentation”*, Tata McGraw Hill, 2017.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 2204	Power System - I	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. impart the knowledge of generation of electricity based on conventional and non-conventional sources 2. enable the students to do analysis of different types of distribution systems and its design 3. make students capable of analysis of mechanical and electrical design aspects of transmission system	<b>Course Outcomes</b>	CO1	Able to understand the basic structure of power generation, transmission and distribution.						Understanding/Comprehension
			CO2	Able to illustrate the various concept and importance of prominent power generation system and its transmission.						Understanding/Comprehension
			CO3	Able to describe the structure of power system, and its various phenomenon, and parameters of transmission line.						Identify/Knowledge/Remember
			CO4	Able to interpret and analyze the mechanical design of overhead transmission line.						Understanding Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Generation of Electric Power:</b> Brief description of Thermal, Hydro, Nuclear and brief description of non-conventional power plants. Merits, Demerits and site selections of the above power plants. Transmissions and distribution of power three-wire four-wire system and service connections	10	CO1 CO2 CO3
II	<b>Calculation of inductance:</b> Inductors, inductance of single phase and three phase unsymmetrically spaced transmission lines. Transposition of power lines, concept of GMD and self-GMD. Bundle conductor, Skin and proximity effect.	12	CO2 CO3
III	<b>Calculation of Capacitance:</b> Two infinite lines of charge, Capacitance of single-phase transmission line, Capacitance of a three-phase unsymmetrically spaced transmission line. Effect of earth on capacitance of conductors	10	CO3 CO4
IV	<b>Mechanical design Transmission Lines and Cables:</b> Introduction, the catenary curve, Sag calculation, Types of insulators, Potential distribution over a string of suspension insulators, Methods of equalising the potential. Calculations of capacity of cables, charging current, stress, grading, heating of cables, Capacitance of a single core cable and three-core cable.	13	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 2011.
2. Harder Edwin.I, "Fundamentals of Energy Production", John Wiley and Sons, 2008.
3. Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Ald 1979
4. Wadhwa, C.L., "Electric Power Systems", 6<sup>th</sup> Edition, Wiley Eastern Limited, 2018.
5. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995

**Reference Books:**

1. Electric Transmission and Distribution Reference Book", Westing house Electric Corporation: East Pittsburg, Pa, 1964.
2. Burke James, J., "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekk., 1996.
3. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology (B.Tech) in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-2206	Power Electronics Laboratory	0	0	2	1	0	0	100	100	
<b>Course Objectives</b>	1. To introduce the fundamental principles of power semiconductor devices and circuits. 2. To study the operation, characteristics, and applications of different types of power converters (AC-DC, DC-DC, AC-AC, DC-AC). 3. To analyze and design power electronic circuits for industrial and renewable energy applications. 4. To understand the role of power electronics in motor drives and power supply systems.	<b>Course Outcomes</b>	CO1	Identify different simulation and analytical softwares for power electronics application. Develop skills for designing, simulating and developing hardwares for power electronic circuits	Understanding/Comprehension					
			CO2	Analyze and design rectifiers, inverters, choppers, and AC voltage controllers.	Understanding/Comprehension					
			CO3	Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.	Identify/Knowledge/Remember					
			CO4	Acquire expertise in usage of modern power electronic hardware and software tools. Analyse simulation results and do effective documentation.	Understanding Analyzing					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I.	Study of IGBT, MOSFET, BJT switching characteristics.	2	CO1
II.	Triggering circuits for SCR, MOSFET, IGBT, BJT & UJT.	2	CO2, CO3
III.	Experimental Evaluation of Class-A, Class-B, Class-C, Class-D and Class-E commutation of thyristor	2	CO2, CO3
IV.	Experimental Evaluation of Step-Up chopper circuit.	2	CO3, CO4
V.	Experimental Evaluation of Step-Down Chopper circuit.	2	CO3, CO4
VI.	Experimental Evaluation of Voltage commutated chopper circuit.	2	CO3, CO4
VII.	Experimental Evaluation of Single-phase full phase-controlled rectifier with R Load, R-L Load and RLE load.	2	CO3, CO4
III.	Experimental Evaluation of Single-phase full bridge Inverter.	2	CO3, CO4
IX.	Experimental Evaluation of Current source inverter circuit.	2	CO3, CO4
X.	Experimental Evaluation of single-phase AC voltage controller.	2	CO3, CO4
XI.	Experimental Evaluation of single phase PWM control.	2	CO3, CO4
XII.	Experimental Evaluation of single phase cyclo-converter.	2	CO3, CO4
<b>Total Hours</b>		<b>24</b>	

**Text Books:**

1. P.S. Bimbhra, Power Electronics, Khanna Publishers, 2012.
2. M.H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson, 2018.
3. Lab Manual Prepared by Dept of Electrical Engineering, NIT Arunachal Pradesh

**Reference Books:**

1. Ned Mohan, Tore M. Undeland, and William P. Robbins, Power Electronics: Converters, Applications, and Design, Wiley, 2002.
2. L.Umanand, Power Electronics: Essentials & Applications, Wiley, 2009.
3. Robert W. Erickson and Dragan Maksimović, Fundamentals of Power Electronics, Springer, 2001.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 2207	Electrical Machines I Laboratory	0	0	2	1	20	30	50	100	
<b>Course Objectives</b>	1. impart the knowledge of transmission line parameters	<b>Course Outcomes</b>	CO1	Conduct standard tests on DC machines and transformers using appropriate instruments and procedures.					Understanding/Comprehension	
	2. enable the students to do analysis of different types of conductors for long transmission line.		CO2	Analyze and interpret performance characteristics such as efficiency, losses, and voltage regulation.					Understanding/Comprehension	
	3. make students capable of analysis of performance of transmission line		CO3	Demonstrate safe handling, operation, and troubleshooting of electrical machines in a laboratory environment.					Identify/Knowledge/Analyzing	
			CO4	Use experimental data to validate theoretical models and apply them to practical engineering problems.					Understanding Analyzing	

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	Magnetization characters of DC Shunt Generator	2	CO1
II	Load test on DC Shunt motor	2	CO2
III	Brake test on DC Shunt motor	2	CO3
IV	Speed control of DC shunt motor	2	CO3
V	Open circuit and Short circuit test on Single phase Transformer	2	CO3
VI	Sumpner,s test on single phase Transformer	2	CO4
<b>Total Hours</b>		<b>12</b>	

**Text Books:**

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 2011.
2. Harder Edwin.I, "Fundamentals of Energy Production", John Wiley and Sons, 2008.
3. Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Ald 1979
4. Wadhwa, C.L., "Electric Power Systems", 6<sup>th</sup> Edition, Wiley Eastern Limited, 2018.

**Reference Books:**

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995
2. Electric Transmission and Distribution Reference Book", Westing house Electric Corporation: East Pittsburg, Pa, 1964.
3. Burke James, J., "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekk., 1996.
4. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 2208	Electrical Machines I Laboratory	0	0	2	1	20	30	50	100	
<b>Course Objectives</b>	1. Provide hands-on experience in performing experiments on DC machines and transformers to reinforce theoretical concepts learned in the classroom. 2. Develop the ability to conduct tests, record observations, and analyze the performance characteristics of electrical machines. 3. Equip students with practical skills for safe operation, testing, and maintenance of electrical machines and related equipment. 4. Foster problem-solving, teamwork, and documentation skills through structured laboratory tasks and technical report writing.	<b>Course Outcomes</b>	CO1	Conduct standard tests on DC machines and transformers using appropriate instruments and procedures.	Understanding/Comprehension					
			CO2	Analyze and interpret performance characteristics such as efficiency, losses, and voltage regulation.	Understanding/Comprehension					
			CO3	Demonstrate safe handling, operation, and troubleshooting of electrical machines in a laboratory environment.	Identify/Knowledge/Analyzing					
			CO4	Use experimental data to validate theoretical models and apply them to practical engineering problems.	Understanding/Analyzing					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	Magnetization characters of DC Shunt Generator	2	CO1
II	Load test on DC Shunt motor	2	CO2
III	Brake test on DC Shunt motor	2	CO3
IV	Speed control of DC shunt motor	2	CO3
V	Open circuit and Short circuit test on Single phase Transformer	2	CO3
VI	Sumpner,s test on single phase Transformer	2	CO4
<b>Total Hours</b>		<b>12</b>	

**Text Books:**

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

**Reference Books:**

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
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3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 2209	Electrical and Electronics Measurement Laboratory	0	0	2	1	0	0	100	100	
<b>Course Objectives</b>	1. develop practical skills in the operation and calibration of electrical and electronic measurement instruments through hands-on experiments. 2. enable students to accurately measure and analyze electrical quantities such as voltage, current, power, and resistance in various circuits. 3. understand and apply measurement error analysis and uncertainty concepts, ensuring precision and reliability in experimental results.	<b>Course Outcomes</b>	CO1	Operate and calibrate various electrical and electronic measuring instruments (e.g., voltmeters, ammeters, oscilloscopes, etc.) to obtain accurate readings.	Understanding/ Applying					
			CO2	Perform electrical measurements in real-world circuits, and apply appropriate measurement techniques for DC/AC signals, power, resistance, etc.	Understanding/ Applying					
			CO3	Evaluate and reduce measurement errors by identifying sources of error and performing uncertainty analysis on collected data.	Identify/ Knowledge/ Remember					
			CO4	Analyze experimental data, present findings, and prepare reports, demonstrating a deep understanding of measurement techniques in electrical and electronics systems.	Understanding Analyzing					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I.	Measurement of low resistance by Kelvin's Double Bridge method.	2	CO2 CO3
II.	Study of Galvanometer and determination of sensitivity and galvanometer constants.	2	CO2 CO3
III.	Measurement of capacitance and loss angle of capacitor using Schering bridge.	2	CO2 CO3
IV.	Measurement of unknown inductance by Maxwell's inductance and capacitance bridge.	2	CO2 CO3
V.	Measurement of inductance and Q-factor using Owen bridge.	2	CO2 CO3
VI.	To measure value of unknown inductance using LCR meter.	2	CO2 CO3
VII.	Measurement of ratio and phase angle errors of instrument transformers	2	CO3 CO4
VIII.	Calibration of voltmeters and ammeters using potentiometer.	2	CO2 CO3
IX.	Measurement of power and power factor in a three phase AC circuit by two-wattmeter method.	2	CO3 CO4
X.	Demonstration of Function generator by understanding different waveform.	2	CO3 CO4
XI.	To demonstrate usage of DSO for steady state periodic waveforms produced by a function generator.	2	CO2 CO3
XII.	To measure high resistance and insulation resistance using Megger.	2	CO2 CO3
<b>Total Hours</b>			

**Text Books:**

1. Shawney A.K., "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai and Sons, 2018
2. Kalsi H. S., "Electronic Instrumentation", Tata McGraw Hill, 2007.
3. Nakra C. & Chaudhary K.K., "Instrumentation Measurement and Analysis", Tata McGraw Hill, 2003.
4. Patranabis. D, "Sensors & Transducers", PHI, 2010

**Reference Books:**

1. Golding E. W. and Widdis F. C., "Electrical Measurements and Measuring Instruments", Pitman, 2003.
2. Helfrick A. D. and Cooper W. D., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.
3. Bernard Oliver and John Cage., "Electronic Measurements and Instrumentation", Tata McGraw Hill, 2017.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 3101	Electrical Machines - II	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Study construction and operation of AC Electrical Machines. 2. Calculation of machine parameters and modelling. 3. Brief study of special electrical motors (PMBL), etc. 4. Introduce theory of machine control and practical applications.	<b>Course Outcomes</b>	CO1	Understand the concepts of rotating magnetic fields.						Understanding/Comprehension
			CO2	Understand the operation of ac machines						Understanding/Comprehension
			CO3	Analyse performance characteristics of ac machines						Identify/Knowledge/Remember

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Fundamentals of AC machine windings:</b> Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor	10	CO1 CO2 CO3
II	<b>Pulsating and revolving magnetic fields:</b> Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90degrees, Addition of pulsating magnetic fields, three windings spatially shifted by 120degrees (carrying three phase balanced currents), revolving magnetic field.	10	CO2 CO3
III	<b>Induction Machines:</b> Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.	10	CO3
IV	<b>Single-phase induction motors:</b> Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications. <b>Synchronous machines:</b> Constructional features, cylindrical rotor synchronous machine -generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V curves. Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.	13	CO2 CO3
<b>Total Hours</b>		<b>43</b>	

**Text Books:**

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013
2. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.

**Reference Books:**

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
3. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
4. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley and Sons, 2007.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 3102	Power System - II	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>impart the knowledge of performance of power system and its faults</li> <li>enable the students to do analysis of different types of tools for solving transmission line faults</li> <li>make students capable of analysis of symmetrical and unsymmetrical faults</li> </ol>	<b>Course Outcomes</b>	CO1	Able to understand the basic performance of transmission line and its operations.					Understanding/Comprehension	
			CO2	Able to illustrate the various concept and importance of transmission line representation and tools for analysis of faults.					Understanding/Comprehension	
			CO3	Able to interpret and analyze the symmetrical components and operator for solving transmission line faults.					Identify/Knowledge/Remember	
			CO4	Able to interpret and analyze the symmetrical, unsymmetrical faults in transmission line, and stability.					Understanding Analyzing	

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Performance of transmission line:</b> Introduction of short, medium and long transmission line, 'Pi' and 'Tee' representation of medium transmission line with ABCD constants, Ferranti effect, transposition, Impedance or reactance diagram. Per unit system, Equivalent circuit diagram of transmission line.	13	CO1 CO2 CO3
II	<b>Symmetrical components:</b> Introduction, operator, sequence impedance and sequence networks on power system, Transmission line, Transformers, Synchronous machine. Positive, Negative and zero sequences in power system.	10	CO2 CO3
III	<b>Unsymmetrical Fault Analysis:</b> Unsymmetrical faults in transmission line, Symmetrical components analysis of unsymmetrical faults. Single – line to ground (LG) fault, Line to line (LL) fault, Double line to ground (LLG) faults, Open Conductor faults. Bus impedance matrix methods for analysing of unsymmetrical faults.	12	CO3 CO4
IV	<b>Symmetrical Fault Analysis:</b> Symmetrical faults in Transmission line, Transients in transmission line, Short circuit analysis of synchronous machine for on load and no load condition. Power System Stability: dynamics of Synchronous machine, Swing equation, Equal Area criterion.	10	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 2011.
- Harder Edwin.I, "Fundamentals of Energy Production", John Wiley and Sons, 2008.
- Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Ald 1979
- Wadhwa, C.L., "Electric Power Systems", 6<sup>th</sup> Edition, Wiley Eastern Limited, 2018.
- Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995

**Reference Books:**

- Electric Transmission and Distribution Reference Book", Westing house Electric Corporation: East Pittsburg, Pa, 1964.
- Burke James, J., "Power Distribution Engineering: Fundamentals and Applications" Marcel Dekk., 1996.
- Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total		
EE – 3103	Electric Drives	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. To introduce the fundamental concepts of electric drives and their importance in motion control systems. 2. To analyze the dynamic and steady-state characteristics of various electrical drives. 3. To study the control of DC and AC drives using power electronic converters. 4. To understand braking, speed control, and torque control strategies for industrial applications. 5. To expose students to modern drive applications in electric vehicles, robotics, and renewable energy systems.	<b>Course Outcomes</b>	CO1	Explain the concept, classification, and components of electrical drives and their characteristics.	Understand / Apply						
			CO2	Analyze the steady-state and transient dynamics of DC and AC drives.	Apply / Analyze						
			CO3	Design and simulate speed and torque control of different drives using converters.	Apply / Create						
			CO4	Evaluate the performance and energy efficiency of various industrial drives.	Analyze / Evaluate						
			CO5	Apply knowledge of drives in practical systems such as EVs and renewable applications.	Apply / Evaluate						

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Fundamentals of Electric Drives:</b> Introduction to Electric Drives, Dynamics of Electric Drives, Four Quadrant Operation, Equivalent Drive Parameters, Friction Components, Nature of Load Torque, Steady State Stability, Load Equalization.	8	CO1 CO2
II	<b>DC Motor Drives:</b> Characteristics of DC Motor, Speed Torque Characteristics of Separately Excited DC Motor and Series DC Motor, Field Control of Series Motor, Motoring and Braking of Separately Excited and Series DC motors, Speed Control of Separately Excited DC Motor Using Controlled Rectifiers, Analysis of Single Phase Full Controlled Converter-fed Separately Excited DC Motor, Speed Torque Characteristics of Full Controlled Converter-fed Separately Excited DC Motor, Analysis of Single Phase Half Controlled Converter-fed Separately Excited DC Motor, Three Phase Full Controlled Converter-fed Separately Excited DC Motor, Multi-quadrant Operation of DC Motor, Dual Converter-fed DC Motor, Multi-quadrant Operation Using Field Current Reversal, DC Chopper-fed Separately Excited DC Motor for Motoring and Braking, Two-quadrant DC Chopper, Four-quadrant DC Chopper. Dynamic Braking of DC Motor by Chopper Controlled Resistor, Closed-loop Operation of DC Drives.	12	CO2 CO3
III	<b>Induction Motor Drives:-</b> Speed Torque Characteristics of Induction Motor, Operation of Induction Motor from Non-sinusoidal Supply, Operation of Induction Motor from Non-sinusoidal Supply, Stator Current of Induction Motor with Non-sinusoidal Supply, Operation of Induction Motor with Unbalanced Voltage Supply, Single Phasing of Induction Motor, Braking of Induction Motor, Dynamic braking of induction motor, AC dynamic braking, DC dynamic braking, Analysis of DC dynamic braking of induction motor, Self-excited dynamic braking of induction motor, Speed control of induction motor using stator voltage regulator, Variable voltage variable frequency control, Variable voltage variable frequency control of induction motor, Open loop V/f control, Slip speed control of induction motor, Constant Volt/Hz control with slip speed regulation, Closed-loop Volt/Hz control of induction motor with slip speed regulation, Multi-quadrant operation of induction motor drive, Current Source Inverter (CSI) fed induction motor drive, Closed-loop operation of current source inverter (CSI) fed induction motor drive, Control of slip ring induction motor - Static rotor resistance control, Closed-loop operation of slip ring induction motor with static rotor resistance control, Slip power recovery in slip ring induction motor - Static Kramer drive and its closed-loop control.	12	CO3 CO4
IV	<b>Synchronous Machine Drive:-</b> Introduction to synchronous motor, Various types of synchronous motors, Equivalent circuit and phasor diagram of cylindrical synchronous motor, Speed-torque characteristics of cylindrical synchronous motor, Phasor diagram of salient pole synchronous motor, Expression of power and torque for a salient pole synchronous motor, Synchronous reluctance motor, Open-loop V/f control of synchronous motor, Open-loop V/f control, Torque-speed characteristics, Self controlled synchronous motor drive employing load commutated thyristor inverter, Detailed analysis of commutation of load commutated thyristor inverter, Derivation of overlap angle and margin angle, Closed-loop speed control scheme for load commutated inverter-fed synchronous motor drive. <b>Special Machine Drive:-</b> Low cost brushless DC motor (BLDCM), Trapezoidal permanent magnet AC motor, Trapezoidal permanent magnet AC motor, Derivation of power and torque, Closed-loop control of trapezoidal BLDC motor, Introduction to switched reluctance motor, Construction and operating principle of switched reluctance motor, Current/ voltage control for switched reluctance motor, operating modes of switched reluctance motor, Introduction to traction drives, Current collector for mainline trains, Nature of traction load, Duty cycle of traction drives, Duty cycle of traction drives, Distance between two stops, Calculation of total tractive effort and drive rating.	13	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. G. K. Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House.
2. R. Krishnan, *Electric Motor Drives: Modeling, Analysis and Control*, Prentice Hall.
3. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
4. N. K. De and P. K. Sen, *Electric Drives*, PHI Learning.

**Reference Books:**

1. W. Leonhard, *Control of Electrical Drives*, Springer.
2. B. K. Bose, *Power Electronics and Motor Drives – Advances and Trends*, Elsevier.
3. Iqbal Husain, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press.
4. N. Mohan, *Advanced Electric Drives – Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
5. K. T. Chau, *Electric Vehicle Machines and Drives: Design, Analysis and Applications*, Wiley.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 3105	Electrical Machines II Laboratory	0	0	2	1	20	30	50	100	
<b>Course Objectives</b>	1. Provide hands-on experience in performing experiments on AC machines and transformers to reinforce theoretical concepts learned in the classroom. 2. Develop the ability to conduct tests, record observations, and analyze the performance characteristics of electrical machines. 3. Equip students with practical skills for safe operation, testing, and maintenance of electrical machines and related equipment. 4. Foster problem-solving, teamwork, and documentation skills through structured laboratory tasks and technical report writing.	<b>Course Outcomes</b>	CO1	Conduct standard tests on AC machines and transformers using appropriate instruments and procedures.	Understanding/Comprehension					
			CO2	Analyze and interpret performance characteristics such as efficiency, losses, and voltage regulation.	Understanding/Comprehension					
			CO3	Demonstrate safe handling, operation, and troubleshooting of electrical machines in a laboratory environment.	Identify/Knowledge/Analyzing					
			CO4	Use experimental data to validate theoretical models and apply them to practical engineering problems.	Understanding Analyzing					

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	NO LOAD AND BLOCKED ROTOR TEST OF A 3- $\phi$ INDUCTION MOTOR	2	CO1
II	BRAKE TEST ON 3- $\phi$ SQUIRRELCAGE INDUCTION MOTOR	2	CO2
III	LOAD TEST ON 3-PHASE AC SLIP RING INDUCTION MOTOR	2	CO3
IV	LOAD TEST ON 1-PHASE INDUCTION MOTOR	2	CO3
V	DETERMINATION OF EQUIVALENT CIRCUIT PARAMETERS of A SINGLE PHASE INDUCTION MOTOR	2	CO3
VI	REGULATION OF ALTERNATOR USING SYNCHRONOUS IMPEDANCE METHOD AND MMF METHOD	2	CO4
VII	SYNCHRONIZATION OF ALTERNATOR BY SYNCRONIZATION PANEL METHOD	2	CO4
VIII	DETERMINATION OF Xd AND Xq OF SALIENT POLE SYNCHRONOUS MOTOR	2	CO4
<b>Total Hours</b>		<b>16</b>	

**Text Books:**

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

**Reference Books:**

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 3106	Power System – II Laboratory	0	0	2	1	20	30	50	100	
<b>Course Objectives</b>	1. impart the knowledge of transmission line tools for analysis of faults. 2. enable the students to do computer programming for analysis of different types of faults for long transmission line. 3. make students capable of analysis of symmetrical and unsymmetrical faults using simulation model	<b>Course Outcomes</b>	CO1	Able to understand the basic tools for power system analysis.					Understanding/Comprehension	
			CO2	Able to illustrate the various overhead faults in the Transmission line.					Understanding/Comprehension	
			CO3	Able to interpret and analyze the various faults in transmission line with programming					Identify/Knowledge/Analyzing	
			CO4	Able to interpret and analyze the analysis of performance of overhead transmission line, like symmetrical and unsymmetrical faults.					Understanding Analyzing	

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	To study of various tools for solving faults in transmission line.	2	CO1
II	To study faults analysis using Bus impedance matrix in MATLAB	2	CO2
III	To model transmission line using MATLAB programming.	2	CO3
IV	To create ZBUILD and SYMFAULT programs for fault analysis	2	CO3
V	To study Single line to Ground (LG) fault using program/Simulink model.	2	CO4
VI	To study Double line to Ground (LLG) fault using program/Simulink model	2	CO4
VII	To Study Single line to Ground (LLL) fault using program/Simulink model.	2	CO4
VIII	To study Line to line (LL) fault using program/Simulink model.	2	CO4
<b>Total Hours</b>		<b>16</b>	

**Text Books:**

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 2011.
2. Harder Edwin.I, "Fundamentals of Energy Production", John Wiley and Sons, 2008.
3. Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Ald 1979
4. Wadhwa, C.L., "Electric Power Systems", 6<sup>th</sup> Edition, Wiley Eastern Limited, 2018.

**Reference Books:**

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995
2. Electric Transmission and Distribution Reference Book", Westing house Electric Corporation: East Pittsburg, Pa, 1964.
3. Burke James, J., "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekk., 1996.
4. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology (B.Tech) in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-3107	Electrical Drives Laboratory	0	0	2	1	0	0	100	100	
<b>Course Objectives</b>	1. To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics 2. To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications. 3. To impart industry-oriented learning. 4. To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation	<b>Course Outcomes</b>	CO1	Analyze the performance characteristics of different motor drives.	Understanding/Comprehension					
			CO2	Set up control strategies to synthesize the voltages in dc and ac motor drives.	Understanding/Comprehension					
			CO3	Identify the components and characteristics of electrical drives.	Identify/Knowledge/Remember					
			CO4	Evaluate efficiency and control techniques of electric drives.	Understanding Analyzing					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I.	Study of thyristor controlled DC Drive.	2	CO1
II.	Study of Chopper fed DC Drive.	2	CO1, CO2
III.	Study of AC Single phase motor-speed control using TRIAC.	2	CO1, CO2
IV.	PWM Inverter fed 3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software.	2	CO1, CO2
V.	VSI / CSI fed Induction motor Drive analysis using MATLAB/DSPICE/PSIM Software.	2	CO2, CO3
VI.	Study of V/f control operation of 3-Phase induction motor drive.	2	CO2, CO3
VII.	Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.	2	CO2, CO3
VIII.	Regenerative / Dynamic braking operation for DC Motor - Study using software.	2	CO3, CO4
IX.	Regenerative / Dynamic braking operation of AC motor - study is using software PC/PLC based AC/DC motor control operation.	2	CO3, CO4
X.	Speed control of permanent magnet synchronous motor using FPGA spartan 6 controllers.	2	CO3, CO4
<b>Total Hours</b>		<b>20</b>	

**Text Books:**

1. Lab Manual of Electric Drives prepared by NIT Arunachal Pradesh
2. G.K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House.
3. Ion Boldea & Syed A. Nasar, *Electric Drives*, CRC Press, 2016

**Reference Books:**

1. R. Krishnan, *Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications*, CRC Press, 2001
2. Austin Hughes & Bill Drury, *Electric Motors and Drives: Fundamentals, Types, and Applications*, Newnes, 2019



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## Department of Electrical Engineering (Skill Development Course)

EE-3108

PLC & SCADA Programming

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### PLC & SCADA Programming

Industrial automation is essential in power plants, manufacturing, and process industries.

Skills gained:

Ladder logic programming

SCADA screen development

Hands-on PLC (Siemens/Allen Bradley/Delta)

Industrial communication protocols

### Electrical CAD (AutoCAD Electrical / E-PLAN)

Students learn how to design professional electrical layouts required by industries.

Skills gained:

Control panel wiring diagrams

Cable scheduling

SLD (Single Line Diagram) creation

Switchgear layout drafting

### Internet of Things (IoT) for Electrical Engineers

Smart grids, smart meters, and automation systems rely heavily on IoT.

Skills gained:

Sensor interfacing

Microcontroller programming (ESP32/Arduino)

Cloud connectivity

Smart energy monitoring applications



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 (Institute of National Importance under Ministry of Education, Govt. of India)

**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	

EE – 310X	Fundamentals of Power Electronics	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To introduce the basic principles and applications of power electronics to students from non-electrical backgrounds.</li> <li>To understand the operation and characteristics of power semiconductor devices.</li> <li>To study the conversion of electrical energy using different converter topologies.</li> <li>To explain the role of power electronics in renewable energy systems, electric vehicles, and automation.</li> <li>To provide hands-on exposure to simulation and practical understanding of converter behaviour.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain the role and significance of power electronics in energy conversion and modern engineering systems.	Understanding / Comprehension					
			CO2	Describe the working principles of major power semiconductor devices and their switching characteristics.	Apply / Analyze					
			CO3	Analyze the operation of basic power converters: rectifiers, DC–DC converters, and inverters.	Apply / Evaluate					
			CO4	Apply power electronics concepts to practical systems such as renewable energy, drives, and consumer electronics.	Analyze / Evaluate					
			CO5	Use simulation tools to study converter performance and efficiency.	Understand / Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Power Electronics:</b> Overview, applications, importance in modern systems; power flow and conversion principles; distinctions between electronics and power electronics. <b>Power Semiconductor Devices:</b> Diodes, SCRs, MOSFETs, IGBTs; static and dynamic characteristics; device ratings and selection; protection and thermal management.	13	CO1 CO2
II	<b>AC–DC Converters (Controlled and Uncontrolled Rectifiers):</b> Single-phase and three-phase rectifiers, half-and full-wave circuits; performance parameters (ripple, efficiency, THD); controlled rectifiers using SCRs.	8	CO2 CO3
III	<b>DC–DC Converters (Choppers):</b> Step-up (boost), step-down (buck), and buck-boost converters; principle of operation, switching waveforms, and applications.	8	CO3 CO4
IV	<b>DC–AC Converters (Inverters):</b> Basic operation of single-phase and three-phase inverters; PWM techniques; voltage and frequency control; applications in UPS and solar systems. <b>Applications and Simulations:</b> Applications in renewable energy, electric vehicles, and household devices; introduction to MATLAB/Simulink-based simulation of converters.	16	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- M. H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, Pearson.
- N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
- P. S. Bimbhra, *Power Electronics*, Khanna Publishers.
- V. Subrahmanyam, *Power Electronics – Devices, Circuits and Industrial Applications*, New Age International.

**Reference Books:**

- B. K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
- R. Krishnan, *Electric Motor Drives: Modeling, Analysis, and Control*, Prentice Hall.
- Fang Lin Luo and Hong Ye, *Fundamentals of DC–DC Converters*, CRC Press.
- Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
- P. C. Sen, *Power Electronics*, Tata McGraw-Hill.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	

EE – 311H	Advanced Power Electronics	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To provide an in-depth understanding of advanced converter topologies and their control.</li> <li>To study modern switching devices and their characteristics in high-frequency applications.</li> <li>To analyse resonant, multilevel, and matrix converters for high-performance systems.</li> <li>To introduce advanced PWM techniques and digital control of power converters.</li> <li>To expose students to practical and emerging applications in EVs, renewable energy, and FACTS.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain modern semiconductor devices and their characteristics for high-frequency converters.	Understanding / Comprehension					
			CO2	Analyse the operation and control of various DC–DC and DC–AC converter topologies.	Apply / Analyze					
			CO3	Design and simulate resonant and soft-switching converters for improved efficiency.	Apply / Evaluate					
			CO4	Develop control algorithms for digital implementation of power converters.	Analyze / Evaluate					
			CO5	Evaluate converter performance in renewable energy, EV, and power quality applications.	Understand / Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Review of Power Semiconductor Devices:</b> IGBTs, MOSFETs, SiC and GaN devices; switching characteristics, snubber design; device protection and thermal management.	14	CO1
	<b>Advanced DC–DC Converters:</b> Interleaved, multiphase, and bidirectional converters; non-isolated and isolated topologies; soft-switching principles; synchronous rectification.		CO2
II	<b>Resonant and Soft-Switching Converters:</b> Series and parallel resonant converters, quasi-resonant converters; zero-voltage and zero-current switching; design equations and waveforms.	17	CO2
	<b>Multilevel and Matrix Converters:</b> Diode-clamped, flying capacitor, cascaded H-bridge topologies; modulation techniques; space vector control; matrix converter fundamentals and control.		CO3
III	<b>Digital Control of Converters:</b> Sampling effects, delay compensation, PWM generation, current and voltage loop design; DSP/microcontroller implementation; simulation using MATLAB/PLECS.	8	CO3 CO4
IV	<b>Applications:</b> Power converters in renewable systems (solar PV, wind), electric vehicles, solid-state transformers, and FACTS devices; EMI/EMC and efficiency optimization.	6	CO3
			CO4
			CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
- B. K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
- R. W. Erickson and D. Maksimovic, *Fundamentals of Power Electronics*, Springer.
- Fang Lin Luo and Hong Ye, *Advanced DC–DC Converters*, CRC Press.

**Reference Books:**

- Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
- Bimal K. Bose, *Power Electronics and Motor Drives – Advances and Trends*, Elsevier.
- Marian K. Kazimierczuk, *Pulse-Width Modulated DC–DC Power Converters*, Wiley.
- Fang Lin Luo, *Soft Switching PWM Inverters: Technology, Performance and Application*, Springer.
- Rashid M. H., *Power Electronics: Devices, Circuits, and Applications*, Pearson.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 320X	Fundamentals of Power Systems (OE)	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. impart the knowledge of generation of electricity based on conventional and non-conventional sources 2. enable the students to do analysis of different types of distribution systems and its design 3. make students capable of analysis of mechanical and electrical design aspects of transmission system	<b>Course Outcomes</b>	CO1	Able to understand the basic structure of power generation, transmission and distribution.						Understanding/Comprehension
			CO2	Able to illustrate the various concept and importance of prominent power generation system and its transmission.						Understanding/Comprehension
			CO3	Able to describe the structure of power system, and its various phenomenon, and parameters of transmission line.						Identify/Knowledge/Remember
			CO4	Able to interpret and analyze the mechanical design of overhead transmission line.						Understanding Analyzing

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Power System:</b> Basic description of Power, current, voltage and frequency, grid, smart-grid. Inductors, inductance of single phase and three phase unsymmetrically spaced transmission lines. Transposition of power lines.	12	CO1 CO2 CO3
II	<b>Power Generation:</b> Brief introduction of Power generation system, including Thermal, Hydro, Nuclear and brief description of non-conventional power plants. Merits, Demerits and site selections of the above power plants concept of GMD and self-GMD. Bundle conductor, Skin and proximity effect.	12	CO2 CO3
III	<b>Mechanical design Transmission Lines:</b> Typical Electric pole, Sag, Types of insulators, Potential distribution over a string of suspension insulators, T and HT poles, Pole vs Towers.	10	CO3 CO4
IV	<b>Power system protection and Domestic connection:</b> Instruction of power system protection, protection of line, transformer, household, CBs, Isolators, lightning arresters. Earthing and neutral line. Transmissions and distribution of power three-wire four-wire system and service connections.	11	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 2011.
2. Harder Edwin, I., "Fundamentals of Energy Production", John Wiley and Sons, 2008.
3. Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Ald 1979
4. Wadhwa, C.L., "Electric Power Systems", 6<sup>th</sup> Edition, Wiley Eastern Limited, 2018.
5. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995

**Reference Books:**

1. Electric Transmission and Distribution Reference Book", Westing house Electric Corporation: East Pittsburg, Pa, 1964.
2. Burke James, J., "Power Distribution Engineering: Fundamentals and Applications" Marcel Dekk., 1996.
3. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 321H	Fundamentals of FACTS	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To introduce the concept and need of Flexible AC Transmission Systems in modern power networks.</li> <li>To understand reactive power compensation and control of power flow in transmission systems.</li> <li>To study various FACTS controllers such as SVC, TCSC, STATCOM, SSSC, and UPFC.</li> <li>To analyze the steady-state and dynamic performance of FACTS devices and their integration.</li> <li>To expose students to simulation, control, and real-world applications of FACTS in smart grids and renewable integration.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain the role, benefits, and components of FACTS in power systems.	Understand / Apply					
			CO2	Analyze reactive power compensation and voltage control using shunt devices.	Analyze					
			CO3	Evaluate the operation and characteristics of series and combined FACTS controllers.	Analyze / Evaluate					
			CO4	Model and design control strategies for FACTS devices using power electronic converters.	Apply / Create					
			CO5	Assess the impact of FACTS on system stability, power quality, and renewable integration.	Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to FACTS:</b> Basic concepts, reactive power flow control, power transfer capability; need for FACTS; comparison with conventional compensation techniques. <b>Reactive Power Compensation:</b> Principles of shunt and series compensation; load compensation; voltage stability improvement; modelling of transmission lines with compensation.	13	CO1 CO2
II	<b>Shunt Controllers:</b> Static VAR Compensator (SVC) – configuration, operation, V–I characteristics, control schemes; STATCOM – voltage source converter, control of reactive power, dynamic response. <b>Series Controllers:</b> Thyristor-Controlled Series Capacitor (TCSC), Thyristor-Switched Series Capacitor (TSSC), Static Synchronous Series Compensator (SSSC) – operation, characteristics, and control.	16	CO2 CO3
III	<b>Combined and Advanced Controllers:</b> Unified Power Flow Controller (UPFC), Interline Power Flow Controller (IPFC), and Generalized Power Flow Controller (GPFC) – principle, operation, and control.	8	CO3 CO4
IV	<b>Applications and Case Studies:</b> FACTS in voltage stability enhancement, damping oscillations, power quality improvement, renewable and HVDC integration; simulation using MATLAB/PSCAD.	8	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- N. G. Hingorani and L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press.
- R. Mohan Mathur and Rajiv K. Varma, *Thyristor-Based FACTS Controllers for Electrical Transmission Systems*, IEEE Press.
- K. R. Padiyar, *FACTS Controllers in Power Transmission and Distribution*, New Age International.
- Narain G. Hingorani, *High-Power Electronics and Flexible AC Transmission Systems*, IEEE Press.

**Reference Books:**

- K. K. Sen and M. L. Sen, *Introduction to FACTS Controllers: Theory, Modeling, and Applications*, Wiley.
- G. D. Galanos et al., *Flexible AC Transmission Systems: Modelling and Control*, Springer.
- Y. H. Song and A. T. Johns, *Flexible AC Transmission Systems (FACTS)*, IET Press.
- A. Ghosh and G. Ledwich, *Power Quality Enhancement Using Custom Power Devices*, Springer.
- B. Singh, *FACTS Controllers for Power Transmission Systems*, IEEE Tutorials.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 321B	Energy Storage Systems and Battery Management	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Understand the fundamentals of energy storage technologies and their role in modern power and transportation systems. 2. Study different battery chemistries, characteristics, modelling, and performance parameters. 3. Understand battery management system (BMS) functions including protection, estimation, balancing, and communication. 4. Learn applications of ESS in electric vehicles, microgrids, and renewable energy systems.	<b>Course Outcomes</b>	CO1	Explain various energy storage technologies, characteristics, and their applications.	Understand / Apply					
			CO2	Describe battery chemistries, construction, and performance characteristics.	Analyze					
			CO3	Analyse battery modelling, SOC/ SOH estimation and charging-discharging characteristics.	Analyze / Evaluate					
			CO4	Explain architecture, functions, and protection features of a Battery Management System (BMS).	Apply / Create					
			CO5	Evaluate ESS/BMS integration in EVs, microgrids, and renewable systems through case studies and simulations.	Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Energy Storage Systems</b> Energy storage concepts; storage needs in EVs, grids, and renewables; comparison of storage technologies – mechanical (pumped hydro, CAES, flywheel), thermal (sensible/latent), electrochemical, chemical fuels; key performance metrics – energy/power density, efficiency, cycle life, safety.	10	CO1 CO2
II	<b>Electrochemical Energy Storage – Battery Fundamentals</b> Battery structure and working principles; primary vs secondary cells; battery materials and chemistries – Lead-acid, Ni-MH, Li-ion (LFP, NMC, NCA), solid-state; characteristics – OCV, internal resistance, C-rate, ageing, temperature effects; battery selection criteria.	10	CO2 CO3
III	<b>Battery Modelling &amp; Performance Analysis</b> Electrical and mathematical models – Rint, Thevenin, PNGV models; SOC, SOH, SOP estimation techniques (coulomb counting, EKF, observers); charge-discharge profiles; efficiency, degradation and cycle life; thermal modelling.	10	CO3 CO4
IV	<b>Battery Management Systems (BMS)</b> BMS architecture – centralized, modular, distributed; hardware components – sensors, microcontrollers, protection circuits; cell balancing (passive & active); communication protocols (CAN, LIN); fault detection, protection algorithms, thermal management strategies.	10	CO3 CO4 CO5
V	<b>Applications of ESS &amp; BMS</b> ESS in electric vehicles, hybrid vehicles, renewable-integrated microgrids, UPS systems; charging strategies – CC-CV, fast charging, smart charging; safety standards (ISO 26262, IEC norms); introduction to simulations using MATLAB/Simulink for ESS and BMS; recent trends – second-life batteries, V2G, solid-state batteries.	5	CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. B. Scrosati, J. Garche, *Electrochemical Energy Storage for Renewable Sources and Grid Balancing*, Elsevier.
2. M. Doyle, *Design and Analysis of Large Lithium-Ion Battery Systems*, Artech House.
3. A. Emadi, *Advanced Electric Drive Vehicles*, CRC Press.

**Reference Books:**

1. R. Huggins, *Advanced Batteries: Materials Science Aspects*, Springer.
2. J. Larminie & J. Lowry, *Electric Vehicle Technology Explained*, Wiley.
3. G. Plett, *Battery Management Systems*, Artech House.
4. M. Ehsani, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*, CRC Press.



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**CURRICULUM**

<b>Programme</b>	Masters in Power Electronics and Sustainable Energy	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	II

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total		
EE – 5205	Soft Computing Techniques in Power Electronics and Renewable Energy	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. Introduce the fundamentals of classical and modern optimization methods for power system applications. 2. Understand mathematical modelling of optimization problems encountered in power systems. 3. Study evolutionary, metaheuristic, and intelligent optimization techniques. 4. Apply optimization tools for economic dispatch, unit commitment, OPF, and renewable integration. 5. Expose students to simulation and software-based implementation of modern optimization algorithms.	<b>Course Outcomes</b>	CO1	Explain the need, principles, and classifications of optimization techniques in power systems.	Understand / Apply						
			CO2	Formulate power system optimization problems such as ED, UC, and OPF using appropriate models.	Analyze						
			CO3	Evaluate and compare classical, evolutionary, and metaheuristic optimization algorithms.	Analyze / Evaluate						
			CO4	Apply modern optimization techniques (GA, PSO, DE, ANN, Fuzzy, Hybrid) to power system problems.	Apply / Create						
			CO5	Analyze case studies of renewable energy integration, congestion management, and planning using optimization tools.	Evaluate / Create						

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Optimization in Power Systems</b> Optimization concepts: objective functions, constraints, feasible region; classification of optimization problems; linear and nonlinear optimization; unconstrained and constrained optimization; convexity, KKT conditions. Applications in power systems: economic dispatch, unit commitment, optimal power flow, capacitor placement, loss minimization, reliability and planning.	13	CO1 CO2
II	<b>Classical Optimization Techniques</b> Linear Programming (LP): formulation, simplex method, duality. Nonlinear Programming (NLP): gradient-based methods, Lagrange multipliers. Quadratic Programming (QP) and dynamic programming: applications to ED and UC. Interior-point methods for OPF.	16	CO2 CO3
III	<b>Evolutionary and Metaheuristic Optimization Techniques</b> Genetic Algorithm (GA): encoding, fitness, selection, crossover, mutation; applications in OPF and UC. Particle Swarm Optimization (PSO): velocity–position update, variants, power system applications. Differential Evolution (DE): mutation strategies, applications. Simulated Annealing (SA), Tabu Search (TS), Ant Colony Optimization (ACO). Comparison of metaheuristics.	8	CO3 CO4
IV	<b>Intelligent and Hybrid Optimization Techniques</b> Fuzzy logic and fuzzy optimization; fuzzy ED and reactive power control. Artificial Neural Networks (ANN): training, validation, forecasting applications. Hybrid methods (GA–PSO, ANN–PSO, Fuzzy–GA). Application to renewable power forecasting, grid integration, and planning.	8	CO3 CO4 CO5
<b>Total Hours</b>		45	

**Text Books:**

1. Kalyanmoy Deb, *Optimization for Engineering Design*, Prentice Hall of India.
2. Jizhong Zhu, *Optimization of Power System Operation*, Wiley-IEEE Press.
3. S. Sivanagaraju & G. Sreenivasan, *Power System Operation and Control*, Pearson.
4. Kalyanmoy Deb, *Optimization for Engineering Design*, Prentice Hall of India.

**Reference Books:**

5. Kalyanmoy Deb, *Multi-Objective Optimization Using Evolutionary Algorithms*, Wiley.

6. James Kennedy & Russell Eberhart, *Swarm Intelligence*, Morgan Kaufmann.
7. D. P. Kothari & I. J. Nagrath, *Modern Power System Analysis*, McGraw-Hill.
8. S. Chakrabarti, M. Pant & C. A. C. Coello, *Metaheuristics for Power Systems*, Springer.



**राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचलप्रदेश**  
**NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH**  
 (शिक्षामंत्रालय, भारत सरकारके तहत राष्ट्रीय महत्वका संस्थान)  
 (Institute of National Importance under Ministry of Education, Govt. of India)

**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 322A	Fundamentals of Solar PV Systems	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Introduce the basic principles of solar energy conversion and photovoltaic (PV) technologies. 2. Study the characteristics, modelling, and performance of solar cells and PV modules. 3. Understand PV system components including inverters, charge controllers, and balance-of-system (BOS) elements. 4. Provide knowledge of PV system design, installation, performance evaluation, and applications.	<b>Course Outcomes</b>	CO1	Understand the fundamentals of solar radiation and principles of photovoltaic energy conversion.	Understand / Apply					
			CO2	Describe solar cell materials, I–V characteristics, PV module behaviour, and performance parameters.	Analyze					
			CO3	Explain PV system components and BOS elements including MPPT, inverters, and storage.	Apply / Create					
			CO4	Analyze and design standalone and grid-connected PV systems.	Analyze / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Solar Energy Basics</b> Solar radiation: extraterrestrial and terrestrial radiation, solar geometry, declination, hour angle, zenith angle, air mass; radiation measurement and estimation; overview of solar energy applications; fundamentals of photovoltaic effect and energy conversion principles.	10	CO1 CO2
II	<b>Solar Cell Fundamentals</b> Structure and working of a solar cell; semiconductor basics; p–n junction under illumination; I–V and P–V characteristics; fill factor, efficiency, effect of temperature and irradiance; solar cell materials – mono/poly crystalline silicon, thin films, perovskites; losses in solar cells.	10	CO2 CO3
III	<b>PV Modules and Arrays</b> Module configurations, series/parallel connections; module ratings; equivalent circuit modelling; shading effects and bypass diodes; IV curve construction; maximum power point and MPPT fundamentals; characterization and testing of modules.	8	CO3 CO4
IV	<b>PV System Components and BOS</b> PV inverters and converter topologies; charge controllers (PWM, MPPT); battery types and sizing for PV systems; mounting structures, cabling, protections, grounding; system monitoring and safety standards; introduction to simulation tools (PVsyst/MATLAB).	12	CO3 CO4 CO5
V	<b>PV System Design and Applications</b> Design of standalone and grid-connected PV systems; load assessment, array sizing, inverter sizing; energy yield estimation; economic analysis (LCOE, payback period); applications: rooftop PV, solar pumping, microgrids; case studies on large-scale PV plants	5	CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. C. S. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, PHI.
2. S. P. Sukhatme & J. K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill.
3. Mukund R. Patel, Solar Photovoltaic Systems: Design and Installation, CRC Press.

**Reference Books:**

1. Messenger & Ventre, Photovoltaic Systems Engineering, CRC Press.
2. James P. Dunlop, Photovoltaic Systems, ATP.
3. Wenham et al., Applied Photovoltaics, Earthscan.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE 322B	Power Plant Engineering	3	0	0	3	20	30	50	100	

<b>Course Objectives</b>	The course is designed to meet with the objectives of:	<b>Course Outcomes</b>		Students on successful completion this module will be able to:	
	1. Understand the working principles of different types of power plants.		<b>CO1</b>	Understand the working principles of thermal, hydro, nuclear, and renewable energy power plants.	Remembering
	2. Learn about the various components and operations involved in power generation.		<b>CO2</b>	Analyze the efficiency and performance of different power generation systems.	Understanding
	3. Analyse the economic and environmental aspects of power generation.		<b>CO3</b>	Identify and explain the role of major components in various power plants.	Applying
	4. Study the recent advancements in power plant engineering.		<b>CO4</b>	Evaluate the economic and environmental aspects of power generation.	Evaluating

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	CO1	✓	✓											✓		
2	CO2	✓	✓	✓										✓		
3	CO3	✓	✓	✓	✓									✓	✓	
4	CO4	✓	✓	✓	✓	✓								✓	✓	✓
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Power Plants:</b> Introduction: Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant. Power plant economics and selection: Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics.	10	CO1, CO2
II	<b>Steam power Plants:</b> Heat Cycles: Working of Rankine cycle, reheats cycle regenerative cycle, reheat regenerative cycles and plot them on P-v and T-s diagram, General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizes and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power.	12	CO1, CO2
III	<b>Diesel power plant:</b> General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. <b>Gas Turbine Plant:</b> Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant.	13	CO1, CO2, CO4
IV	<b>Nuclear power plant:</b> Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. <b>Hydroelectric station:</b> Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. <b>Non-Conventional Power Plants:</b> Introduction to non-conventional power plants (Solar, wind, geothermal, tidal) etc	10	CO3, CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- P.K. Nag, "Power Plant Engineering," McGraw-Hill Education, 2014.
- M.M. El-Wakil, "Power Plant Technology," McGraw-Hill Education, 2010.
- R.K. Rajput, "Power Plant Engineering," Laxmi Publications, 2016.

**Reference Books:**

- S.C. Arora and S. Domkundwar, "A Course in Power Plant Engineering," Dhanpat Rai & Co., 2006.
- G.R. Nagpal, "Power Plant Engineering," Khanna Publishers, 2012.
- Black & Veatch, "Power Plant Engineering," Springer, 1996.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 323B	Electrical Drives and Motor Control.	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To understand the fundamental principles of electrical drives and their control characteristics.</li> <li>To analyze steady-state and dynamic performance of DC and AC drives.</li> <li>To develop mathematical models of electric machines and drive systems for simulation and control.</li> <li>To study modern control techniques such as vector control (FOC), direct torque control (DTC), and digital implementation using microcontrollers/DSPs.</li> <li>To introduce industrial applications of drives in EVs, robotics, and renewable energy systems.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain the basic structure, dynamics, and characteristics of electrical drives.	Understand / Apply					
			CO2	Analyze torque-speed characteristics and steady-state operation of DC and AC drives.	Analyze					
			CO3	Develop mathematical models for DC motors, induction motors, and synchronous drives for control design.	Apply / Create					
			CO4	Design and simulate closed-loop speed and torque control of drives using modern control strategies (FOC, DTC).	Analyze / Create					
			CO5	Evaluate and compare drive performance for various industrial and EV applications.	Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Introduction to Electrical Drives:</b> Components of an electrical drive; types of loads and load torque characteristics; multi-quadrant operation; speed-torque relations; dynamics of motor-load systems; selection of motor rating.	15	CO1
	<b>DC Drives:</b> Speed control of DC motors – armature voltage and field control methods; single-phase and three-phase converter-fed DC drives; chopper-controlled DC drives; closed-loop speed control and current limit control.		CO2
<b>II</b>	<b>Induction Motor Drives:</b> Scalar control (V/f control), vector control (FOC), and direct torque control (DTC); speed control with voltage-source inverters and current-source inverters; slip power recovery schemes; braking and regenerative operation.	10	CO2
			CO3
<b>III</b>	<b>Synchronous Motor Drives:</b> Self-controlled synchronous motor drives; load commutated inverter-fed drives; PMSM and BLDC drives; torque and speed control strategies	8	CO3
			CO4
<b>IV</b>	<b>Digital and Advanced Control of Drives:</b> Microcontroller/DSP-based implementation; current, torque, and flux estimation; PWM generation; encoder and sensor interfacing; drive modelling and simulation using MATLAB/Simulink. <b>Applications and Case Studies:</b> Industrial drive applications; drives in EVs, renewable systems, and robotics; energy efficiency and regenerative braking; standards and safety aspects.	12	CO3
			CO4
			CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education.
- G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing.
- R. Krishnan, *Electric Motor Drives: Modelling, Analysis and Control*, Prentice Hall.
- N. K. De & P. K. Sen, Electric Drives, PHI Learning.
- W. Leonhard, Control of Electrical Drives, Springer.

**Reference Books:**

- B. K. Bose, Power Electronics and Motor Drives – Advances and Trends, Elsevier.
- Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.
- R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press.
- N. Mohan, Advanced Electric Drives – Analysis, Control, and Modeling Using MATLAB/Simulink, Wiley.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 323B	Power Electronics and Grid Integration of Renewable Energy Sources	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Introduce the fundamentals of power electronic converters used in renewable energy systems. 2. Study the characteristics of wind, solar, and other renewable sources from a grid-integration perspective. 3. Understand control, interface requirements, and protection of grid-connected renewable systems. 4. Provide knowledge of standards, power quality issues, and modern trends in renewable grid integration.	<b>Course Outcomes</b>	CO1	Explain the characteristics of renewable energy sources and their grid-integration requirements.	Understand / Apply					
			CO2	Describe the operation of power electronic converters used in solar PV, wind, and hybrid systems.	Analyze					
			CO3	Analyze control strategies for power converters, MPPT techniques, and inverter control for grid injection.	Apply / Create					
			CO4	Evaluate power quality issues, standards, protection, and stability aspects of renewable-integrated grids.	Analyze / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Renewable Energy Sources and Grid Requirements</b> Overview of solar PV, wind, small hydro, fuel cells, and hybrid systems; characteristics of RES; variability, intermittency, and forecasting; grid codes and interconnection standards; voltage and frequency requirements; synchronization basics.	15	CO1 CO2
II	<b>Power Electronics for Renewable Energy Systems</b> Converter topologies for RES: DC-DC converters (buck, boost, buck-boost, interleaved), single-phase and three-phase inverters; multilevel inverters (NPC, cascaded, flying capacitor); soft-switching concepts; converter modelling basics.	10	CO2 CO3
III	<b>Control of Converters and MPPT</b> Control of DC-DC converters; MPPT algorithms – Perturb & Observe, Incremental Conductance, Hill-Climbing, Fuzzy/AI-based MPPT; grid-tied inverter control – current control, PLL, PWM techniques; reactive power control; power factor correction.	8	CO3 CO4
IV	<b>Grid Integration Techniques</b> Grid-connected solar PV systems: configurations, anti-islanding, protections; wind energy conversion systems (WECS): SCIG, DFIG, PMSG-based systems and their converters; harmonic compensation, filtering; LVRT/FRT requirements; microgrid architecture and control. Power quality issues in RES: flicker, harmonics, voltage unbalance, transients; mitigation techniques; system protection, grounding, and insulation coordination; energy storage integration; smart inverters; hybrid AC/DC grids; recent standards (IEEE 1547, IEC 61727).	12	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. B. K. Bose, *Power Electronics and Motor Drives: Advances and Trends*, Academic Press.
2. N. Mohan, T. Undeland & W. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
3. Remus Teodorescu, Marco Liserre & Pedro Rodriguez, *Grid Converters for Photovoltaic and Wind Power Systems*, Wiley.

**Reference Books:**

1. S. B. Kjaer, *Grid-Connected Renewable Energy Systems*, Wiley.
2. Fang Lin Luo & Hong Ye, *Renewable Energy Systems: Advanced Conversion Technologies*, CRC Press.
3. Erickson & Maksimovic, *Fundamentals of Power Electronics*, Springer.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 3201	Switchgear and Protection	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. Realize the basic protective schemes applied in power system protection. 2. Educate the new developments in power system protection. 3. Emphasize the significance and application of protection for electrical equipment.	<b>Course Outcomes</b>	CO1	Understand the fundamental concepts of protection schemes in power systems.	Understanding/Comprehension						
			CO2	Explain the structural and operational features of current interruption, circuit breakers, and arc quenching techniques.	Understanding/Comprehension						
			CO3	Identify various protection schemes and protection requirement for alternators, transformers, and transmission lines.	Identify/Knowledge/Remember						
			CO4	Identify, apply and calculate settings for over current, directional over current, distance, differential and pilot protection schemes for transmission lines.	Understanding Analyzing						

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	CO1	✓	✓											✓		
2	CO2	✓	✓	✓										✓		
3	CO3	✓	✓	✓	✓									✓	✓	
4	CO4	✓	✓	✓	✓	✓								✓	✓	✓
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to protective schemes:</b> Requirement of circuit breakers, characteristics of an electric Arc, principle of AC and DC arc interruption, Recovery voltage, re-striking voltage and effect of current asymmetry upon them, current chopping, resistance switching. Need for protective systems, Component of protective systems, Zones of protection, Importance of protective relaying for power systems, fundamental requirements of a good protection scheme–Primary and Back-up Relaying and Instruments Transformers.	10	CO1, CO2, CO3
II	<b>Circuit Breakers:</b> Fusing element, classification of fuses, current carrying capacity of fuses, high rupturing capacity (H.R.C.) cartridge fuses, characteristics of H.R.C. fuses, selection of HRC fuses. Types of AC and DC circuit breakers in general, oil circuit breaker, plain break and controlled break, minimum oil circuit breaker, air blast circuit breaker, vacuum and SF6 circuit breaker, introduction to miniature case circuit breaker and moulded case circuit breaker, Calculation of fault MVA for symmetrical short circuits and determination of circuit breaker capacity, circuit breaker ratings.	12	CO2, CO3
III	<b>Alternator &amp; Transformer Protection:</b> Different types of faults, differential protection with biasing, restricted earth fault protection, negative sequence protection, automatic field suppression and neutral circuit breakers. Buchholz relay, Biased differential protection, PSM, IDMT relays, restricted earth fault protection, harmonic restraint, protection of combined alternator and transformer.	13	CO3, CO4
IV	<b>Transmission Line Protection and busbar/feeder protection:</b> Transmission line protection using: Over current relays, Distance relays, Pilot relays <b>Over current relays:</b> selection of time/current settings, protection of radial feeders, parallel feeders and ring mains. <b>Distance relays:</b> use of impedance, reactance and mho relays for transmission line protection. <b>Pilot relays:</b> use of wire pilot, carrier current pilot and microwave pilot for the transmission line protection. Protection of busbars/feeders etc.	10	CO2, CO3, CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Badriram & Vishwakarma, "Power System Protection", Tata McGraw-Hill Education, 10th reprint, 2015.
2. Paithankar Y. G., S. R. Bhide., "Fundamentals of power system protection" PHI Learning Pvt. Ltd., 10th reprint, 2010.
3. Rao Sunil S., Switchgear Protection and Power Systems, Khanna Publishers, 2009.
4. B Rabindranath and M Chander Power System Protection and Switchgear by, Wiley Eastern (1977)

**Reference Books:**

1. Ravindra Nath B. & Chandar M., Power Systems Protection and Switchgear, New Age International, 3rd Reprint, 2014.
2. Electric Transmission and Distribution Reference Book, Westinghouse Electric Corporation, 1964.
3. Gupta J. B., A Course in Power Systems, S. K. Kataria & Sons, 2009.
4. Warrington Van, Principles of Relaying, Y. G. Paithankar, TMH, 2009.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology (B.Tech) in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-3204	Switchgear and Protection Laboratory	0	0	2	1	0	0	100	100	
<b>Course Objectives</b>	1. Provide hands-on experience with protection devices and switchgear components. 2. Familiarize students with relay characteristics, coordination, and testing procedures. 3. Demonstrate practical operation of circuit breakers and fault analysis. 4. Develop the ability to test, calibrate, and analyze protection schemes used in power systems.	<b>Course Outcomes</b>	CO1	Identify and understand the functions of switchgear components and protection devices.	Understanding/Comprehension					
			CO2	Conduct testing and calibration of various relays used in power systems.	Understanding/Comprehension					
			CO3	Analyze characteristics of relays and protection schemes through experiments.	Identify/Knowledge/Remember					
			CO4	Evaluate the performance of switchgear devices under different fault conditions	Understanding Analyzing					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I.	Study of Switchgear Components	2	CO1
II.	Determination of Overcurrent Relay Characteristics	2	CO1, CO2
III.	Testing and Calibration of Directional Overcurrent Relay	2	CO1, CO2
IV.	Characteristics of Differential Protection Scheme	2	CO1, CO2
V.	Earth Fault Relay Testing	2	CO2, CO3
VI.	Study and Testing of Distance Relay (Impedance/Reactance/Mho)	2	CO2, CO3
<b>Total Hours</b>		<b>12</b>	

**Text Books:**

1. Badriram & Vishwakarma, "Power System Protection", Tata McGraw-Hill Education, 10th reprint, 2015.
2. Paithankar Y. G., S. R. Bhide., "Fundamentals of power system protection" PHI Learning Pvt. Ltd., 10th reprint, 2010.
3. Rao Sunil S., Switchgear Protection and Power Systems, Khanna Publishers, 2009.

**Reference Books:**

1. Ravindra Nath B. & Chandar M., Power Systems Protection and Switchgear, New Age International, 3rd Reprint, 2014.
2. Electric Transmission and Distribution Reference Book, Westinghouse Electric Corporation, 1964.
3. Gupta J. B., A Course in Power Systems, S. K. Kataria & Sons, 2009.
4. Warrington Van, Principles of Relaying, Y. G. Paithankar, TMH, 2009.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology (B.Tech) in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-3205	Non-Conventional Energy Systems Laboratory	0	0	2	1	0	0	100	100	
<b>Course Objectives</b>		<b>Course Outcomes</b>	CO1							Understanding/Comprehension
			CO2							Understanding/Comprehension
			CO3							Identify/Knowledge/Remember
			CO4							Understanding Analyzing

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I.		2	CO1
II.		2	CO1, CO2
III.		2	CO1, CO2
IV.		2	CO1, CO2
V.		2	CO2, CO3
VI.		2	CO2, CO3
<b>Total Hours</b>		<b>12</b>	

**Text Books:**

1. **Photovoltaic Systems: Fundamentals and Applications**, Springer — provides a good blend of theory and practical system design. SpringerLink
2. **Solar Energy: The Physics and Engineering of Photovoltaic Conversion, Technologies, and Systems**, Arno Smets, Klaus Jäger, Olindo Isabella, René van Swaaij & Miro Zeman — deep dive into PV physics + system-level engineering. Bloomsbury Publishing+1
3. **Solar Photovoltaic Technology and Systems: A Manual**, Chetan Singh Solanki — very practical, especially useful for technicians, lab work, and hands-on system design.

**Reference Books:**

4. Science and Technology of Photovoltaics, P. Jayarama Reddy — covers PV technologies, module behavior, and system fundamentals. Routledge
5. Solar Electric Power Generation: Photovoltaic Energy Systems, Stefan C. W. Krauter — focuses on performance modeling (optical, thermal, electrical), yield, and life-cycle aspects. SpringerLink
6. Handbook of Photovoltaic Systems Engineering, Tamer Khatib — detailed design, installation practices, and engineering guidelines. Elsevier Shop
7. Photovoltaic Engineering Handbook, F. Lasnier — covers practical engineering challenges, module design, and system setup.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology (B.Tech) in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-3205	Non-Conventional Energy Systems Laboratory	0	0	2	1	0	0	100	100	
<b>Course Objectives</b>	1. Provide hands-on exposure to non-conventional/renewable energy technologies. 2. Demonstrate the performance characteristics of solar, wind, fuel cells, and biomass systems. 3. Develop skills in measuring, analysing, and evaluating renewable energy system behaviour. 4. Equip students to work with small-scale renewable energy setups safely and effectively.	<b>Course Outcomes</b>	CO1	Identify components and working principles of various non-conventional energy systems.	Understanding/Comprehension					
			CO2	Perform experiments to study performance characteristics of solar, wind, and fuel cell systems.	Understanding/Comprehension					
			CO3	Analyze efficiency, output variations, and operational characteristics under different conditions.	Identify/Knowledge/Remember					
			CO4	Evaluate the feasibility and integration aspects of non-conventional energy systems.	Understanding Analyzing					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I.	Study of Non-Conventional Energy Systems Components	2	CO1
II.	I-V Characteristics of a Solar PV Module	2	CO1, CO2
III.	Performance of Wind Energy Conversion System (WECS)	2	CO1, CO2
IV.	Study of Fuel Cell Characteristics	2	CO1, CO2
V.	Performance Evaluation of a Solar Thermal System	2	CO2, CO3
VI.	Study of Biogas Generation and Utilization System	2	CO2, CO3
<b>Total Hours</b>		<b>12</b>	

**Text Books:**

1. **G. D. Rai**, *Non-Conventional Energy Sources* — Khanna Publishers. TRECA+1
2. **G. N. Tiwari & M. K. Ghosal**, *Renewable Energy Resources: Basic Principles and Applications* — Alpha Science. WorldCat
3. **R. K. Rajput**, *Non-Conventional Energy Sources and Utilisation* — S. Chand Publishing.

**Reference Books:**

1. **John Twidell & Tony Weir**, *Renewable Energy Resources* — Routledge / Taylor & Francis. [Routledge+1](#)
2. **K. M. Mittal**, *Non-Conventional Energy Systems* — Wheeler Publishing. [Sanfoundry](#)
3. **Ashok V. Desai**, *Non-Conventional Energy* — Wiley Eastern. [SITAMS](#)
4. **S. P. Sukhatme & J. K. Nayak**, *Solar Energy: Principles of Thermal Collection and Storage* — McGraw-Hill.



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## Department of Electrical Engineering (Skill Development Course)

EE-3206

Electric Vehicle (EV) Technology & Battery Management

0 0 2: 1

EV architecture & powertrain

Motor controllers and power electronics

Battery management systems (BMS)

Charging standards & protocols

MATLAB/Simulink EV modelling



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE 412C	EV Charging Infrastructure and smart Grid Integration	3	0	0	3	20	30	50	100	

Course Objectives	Course Outcomes	CO1		CO2		CO3		CO4		CO5	
		Description	Understanding/Comprehension	Description	Understanding/Comprehension	Description	Identify/Knowledge/Remember	Description	Understanding/Comprehension	Description	Understanding/Comprehension
1. Provide fundamental understanding of electric vehicles and charging technologies.	1. Provide fundamental understanding of electric vehicles and charging technologies. 2. Enable knowledge of grid integration challenges, power quality issues, and standards. 3. Develop skills in designing EV charging systems and evaluating charging load impacts. 4. Familiarize students with smart grid communication technologies and control strategies. 5. Introduce renewable-integrated EV charging systems and emerging trends (V2G/G2V)	Explain EV fundamentals, charging types, and national/international charging standards.	Understanding/Comprehension	Analyze charging load characteristics and their impact on distribution networks.	Understanding/Comprehension	Design EV charging infrastructure considering electrical, safety, and regulatory guidelines.	Identify/Knowledge/Remember	Evaluate smart grid communication protocols and control methods for EV integration.	Understanding/Comprehension	Assess renewable-integrated EV charging systems and V2G/G2V technologies.	Understanding/Comprehension

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	CO1	3	3	2	2	2	1	2	1	1	2	1	2	3	2	1
2	CO2	3	2	3	3	3	1	2	1	1	2	2	2	3	3	2
3	CO3	2	3	3	3	2	1	3	2	2	3	2	3	2	3	3
4	CO4	2	2	3	3	3	2	2	1	2	3	3	3	2	3	3
5	CO5	2	2	2	3	2	3	3	2	2	3	3	3	2	2	3
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Overview of Electric Vehicles &amp; Charging Fundamentals:</b> Introduction to EVs: BEV, HEV, PHEV, EV powertrain components, Battery technologies: Li-ion, NiMH, BMS basics, charging fundamentals: power levels, AC/DC charging, onboard/off-board chargers, Introduction to grid-connected charging, Charging infrastructure components.	12	CO1 CO2 CO3
II	<b>Charging Standards, Power Electronics &amp; Station Design:</b> EV charging standards: Bharat Standards, SAE J1772, CCS, CHAdeMO, IEC 61851, IEC 62196, Slow/fast/ultrafast charging modes, Design of EV charging stations, Power electronics for EV charging: rectifiers, DC-DC converters, inverters, Harmonics, power quality issues, Metering, protection and safety, earthing.	10	CO2 CO3
III	<b>Smart Grid Integration &amp; Distribution Network Impacts:</b> Smart grid architecture: AMI, DER integration, microgrids, EV-Grid interaction: load profiling, peak demand, feeder loading, Impact on voltage stability, power quality, transformer loading, Smart charging strategies: coordinated charging, demand response, Communication protocols: OCPP, IEC 61850, V2G communication.	12	CO3 CO4
IV	<b>V2G Technologies, Renewable Integration, Policies &amp; Future Trends:</b> Vehicle-to-Grid (V2G), Vehicle-to-Home (V2H), Vehicle-to-Building (V2B), Renewable-based charging stations (PV-EV charging, hybrid systems), Energy storage integration for EV charging, Cybersecurity in EV charging, Economics of EV charging infrastructure, Policies and future research trends	11	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. *Electric Vehicle Integration via Smart Charging*, Vahid Vahidinasab, Behnam Mohammadi-Ivatloo., Springer (Cham), 2022
2. *ICT for Electric Vehicle Integration with the Smart Grid*, Nand Kishor, Jesús Fraile-Ardanuy, The Institution of Engineering and Technology (IET), 2019/2020

**Reference Books:**

1. *Technologies and Applications for Smart Charging of Electric and Plug-In Hybrid Vehicles*, Ottorino Veneri, Springer, 2017
2. *Electric Vehicle Integration in a Smart Microgrid Environment*, Mohammad Saad Alam, CRC Pr I Llc; 1st edition (20 August 2021); CRC Press
3. *Smart Grid and Enabling Technologies*, By Shady S. Refaat, Omar Ellabban, Sertac Bayhan, Haitham Abu-Rub, Frede Blaabjerg, Miroslav M. Begovic, Wiley-IEEE Press.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE 413C	Embedded System Design	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. To understand the fundamentals of embedded systems and microcontroller architectures. 2. To develop skills in programming embedded systems using C/Assembly. 3. To analyze hardware–software co-design and interfacing in embedded systems. 4. To explore real-time operating systems and embedded communication protocols. 5. To design and evaluate embedded solutions for electrical engineering applications	<b>Course Outcomes</b>	CO1	Explain the fundamentals and architecture of embedded systems and microcontrollers.	Understanding/Comprehension					
			CO2	Develop embedded programs using C/Assembly for real-time applications.	Understanding/Comprehension					
			CO3	Design and interface sensors, actuators, and communication modules with microcontrollers.	Identify/Knowledge/Remember					
			CO4	Analyze real-time operating systems, embedded communication buses, and protocols.	Understanding/Comprehension					
			CO5	Apply embedded system concepts to design EE-based applications (motor control, power electronics, automation).	Understanding/Comprehension					

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	CO1	3	3	2	2	2	1	2	1	1	2	1	2	3	2	1
2	CO2	3	2	3	3	3	1	2	1	1	2	2	2	3	3	2
3	CO3	2	3	3	3	2	1	3	2	2	3	2	3	2	3	3
4	CO4	2	2	3	3	3	2	2	1	2	3	3	3	2	3	3
5	CO5	2	2	2	3	2	3	3	2	2	3	3	3	2	2	3
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Embedded Systems &amp; Architecture:</b> Definition, characteristics, and applications of embedded systems, Processor selection, microcontroller vs microprocessor, Architecture of 8051, ARM Cortex-M series, Instruction sets, addressing modes, Memory organization, I/O ports, Embedded hardware components: timers, ADC, DAC, interrupts.	12	CO1 CO2
II	<b>Embedded Programming &amp; Interfacing:</b> Embedded C programming fundamentals, Interrupt-driven programming, Timer/counter programming, GPIO interfacing, Sensor interfacing (temperature, IR, ultrasonic, Hall-effect), Actuator interfacing (motors, relays, solenoids, drivers), ADC/DAC interfacing.	10	CO1 CO2
III	<b>Communication Protocols &amp; Hardware–Software Co-design:</b> Serial communication: UART, SPI, I2C, CAN, LIN, MODBUS (intro), Wireless modules: Bluetooth, Wi-Fi, ZigBee Hardware–software co-design concepts, Embedded development tools: IDEs, debuggers, simulators design basics for embedded systems.	12	CO1, CO2, CO3 CO4
IV	<b>RTOS concepts: tasks, scheduling, semaphores, mutex, inter-task communication:</b> FreeRTOS basics, Power optimization in embedded systems, Embedded system applications in: motor control, renewable energy systems, power electronics control, automation & IoT in electrical engineering, Case studies, Mini design project.	11	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things*, Peter Marwedel, Springer (Cham)2018 (3rd ed.) SpringerLink Also a 2021 edition
- Embedded System Design with ARM Cortex-M Microcontrollers*, Cem Ünsalan, Hüseyin Deniz Gürhan, Mehmet Erkin Yücel, Springer,2022

**Reference Books:**

- A Beginner's Guide to Designing Embedded System Applications on Arm Cortex-M Microcontrollers*, Ariel Lutenberg, Pablo Gomez, Eric Pernia, Arm Education Media, 2022
- Design Principles for Embedded Systems*, K. C. S. Murti, Springer Singapore,2022.
- Efficient Embedded Systems (Nucleo Edition)*, Alexander G. Dean, Arm Education / Academic Press, 2nd Edition (recent)



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE 414A	Smart and Green Building	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. To introduce the concept, need, and relevance of smart and green building technologies for sustainable development. 2. To familiarize students with green building materials, energy-efficient design strategies, and lighting systems. 3. To enable understanding of smart sensors, IoT, building automation, and intelligent control technologies used in modern buildings. 4. To provide knowledge of renewable-energy integration, water conservation, waste management, and environmental impact assessment in buildings. 5. To empower students to evaluate and propose sustainable, economically viable, and environmentally responsible smart building solutions.	<b>Course Outcomes</b>	<b>CO1</b>	Understand fundamentals of smart building technologies, sustainability principles, and rating systems.	Understanding/Comprehension					
			<b>CO2</b>	Analyze green materials, building envelope, and energy-efficient lighting design.	Understanding/Comprehension					
			<b>CO3</b>	Design integrated building systems including HVAC, lighting, and renewable-energy systems.	Identify/Knowledge/Remember					
			<b>CO4</b>	Evaluate smart sensors, IoT-based automation, and building management systems.	Understanding/Comprehension					
			<b>CO5</b>	Assess economic, environmental, and societal impacts of smart and green buildings.	Understanding/Comprehension					

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	CO1	3	2	2	1	0	1	0	0	1	0	0	0	2	1	0
2	CO2	3	3	2	2	1	1	0	0	1	0	0	0	3	2	1
3	CO3	2	3	3	3	2	2	0	1	1	0	0	0	3	3	2
4	CO4	2	2	3	2	2	2	1	1	1	0	0	0	2	3	3
5	CO5	1	2	2	3	3	2	1	1	2	0	0	0	1	2	3
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Introduction to Smart and Green Buildings</b> Definition, concepts, and need for smart and green buildings, Building performance: energy, comfort, air quality, water efficiency, Sustainability principles and life-cycle assessment, Green building rating systems: IGBC, GRIHA, LEED, Codes and guidelines for green building design.	12	CO1 CO2
<b>II</b>	<b>Building Materials, Energy Efficiency and Lighting:</b> Green and sustainable building materials, Embodied energy, thermal insulation, shading devices, Building envelope design and passive strategies, Daylighting: principles, design considerations, Efficient artificial lighting systems and lighting automation'	10	CO2 CO3
<b>III</b>	<b>Smart Systems, Sensors and Automation:</b> Smart sensors: occupancy, CO <sub>2</sub> , light, humidity, temperature, IoT communication protocols: wired and wireless (ZigBee, BLE, Wi-Fi), Building Automation (BAS) and Building Management System (BMS), Smart HVAC, smart metering, load control, Data analytics for energy optimization.	12	CO1, CO4
<b>IV</b>	<b>Renewable Integration, Water &amp; Waste Management:</b> Solar PV integration, energy storage, smart grid connectivity, Water-efficient fixtures, rainwater harvesting, greywater recycling, STP systems for buildings, Solid waste management and recycling technologies, Environmental & economic analysis of smart and green buildings.	11	CO3 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. *Green and Smart Buildings: Advanced Technology Options* Nilesh Y. Jadhav Springer, 2016
2. *Sustainable Technologies for Energy Efficient Buildings*, Chandan Swaroop Meena, Ashwani Kumar, Varun Pratap Singh, Aritra Ghosh (eds.), 2024

**Reference Books:**

1. *Integrated Building Intelligence*, Hamidreza Alavi, Soheila Kookalani, Farzad Rahimian, Núria Forcada, CRC Press / Routledge, 2024
2. *Handbook of Energy Systems in Green Buildings*, Ruzhu Wang, Xiaoqiang Zhai (eds.), Springer (Cham), 2024
3. *Control of Smart Buildings: An Integration to Grid and Local Energy Communities*, Anuradha Tomar, Phuong H. Nguyen, Sukumar Mishra (eds.), Springer, 2022



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-410H	Non-linear Control Systems	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. Understand the fundamental characteristics and mathematical modeling of nonlinear systems.</li> <li>2. Analyze nonlinear system behavior using phase-plane and describing function techniques.</li> <li>3. Apply Lyapunov's method to determine the stability of nonlinear systems.</li> <li>4. Design nonlinear controllers using feedback linearization and sliding mode control.</li> <li>5. Evaluate and implement nonlinear control strategies in real-world engineering applications.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain different types of nonlinearities and their effects on system behavior.	Understand					
			CO2	Construct phase-plane trajectories and determine stability using describing functions.	Apply					
			CO3	Assess system stability using Lyapunov's direct and indirect methods.	Analyze					
			CO4	Design feedback linearization and sliding mode control schemes for nonlinear systems.	Create					
			CO5	Evaluate nonlinear control performance for real-world applications such as robotics or power converters.	Evaluate					

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	CO1	3	2										1			
2	CO2	2	3		2											
3	CO3	2	3		2								1			
4	CO4	2	2	3		3										
5	CO5	1	2	3		2							2			
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	Introduction to Nonlinear Systems: Sources and types of nonlinearities (saturation, dead-zone, backlash, relay, hysteresis); characteristics of nonlinear systems; comparison of linear vs. nonlinear behaviour; state-space representation of nonlinear systems.	8	CO1
II	Phase Plane Analysis: Phase trajectories; singular points and equilibrium; construction of phase portraits; linearization and small-signal analysis; limit cycles; examples: Van der Pol oscillator, pendulum system.	8	CO2
III	Describing Function Analysis: Basic concept of describing function; describing functions for common nonlinearities; graphical analysis; stability and limit cycle prediction using describing function.	8	CO2
IV	Lyapunov Stability: Concepts of stability: BIBO, asymptotic, and exponential; Lyapunov's direct and indirect methods; Krasovskii's method; region of attraction; stability theorems and illustrative examples.	10	CO3
V	Modern Nonlinear Control Techniques: Feedback linearization; input-output linearization; sliding mode control; adaptive control; backstepping; applications to robotics and power electronics.	11	CO4, CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. H. K. Khalil, Nonlinear Systems, Pearson Education.
2. S. Sastry, Nonlinear Systems: Analysis, Stability, and Control, Springer.
3. J.-J. Slotine and W. Li, Applied Nonlinear Control, Prentice Hall.

**Reference Books:**

1. A. Isidori, Nonlinear Control Systems, Springer.
2. M. Vidyasagar, Nonlinear Systems Analysis, SIAM.
3. R. Marino & P. Tomei, Nonlinear Control Design: Geometric, Adaptive and Robust, Prentice Hall.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total		
EE – 411C	Power System Restructuring and Deregulation	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. Introduce the concepts, motivation, and framework of restructuring and deregulation in power systems. 2. Understand market models, pricing mechanisms, and ancillary services. 3. Study the operation of electricity markets including bidding, congestion management, and settlements. 4. Analyze transmission rights, market power, and regulatory issues. 5. Familiarize students with global case studies and software tools for electricity market simulation.	<b>Course Outcomes</b>	CO1	Explain the need, evolution, and structure of deregulated power systems.	Understanding / Comprehension						
			CO2	Analyze market models, pricing methods, and market equilibrium concepts.	Apply / Analyze						
			CO3	Evaluate congestion management, ATC/ TTC computation, and transmission pricing approaches	Apply / Evaluate						
			CO4	Assess ancillary services, market power, and regulatory issues in electricity markets.	Analyze / Evaluate						
			CO5	Apply optimization and computational methods for market simulation and studies.	Understand / Evaluate / Create						

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Restructuring and Deregulation</b> Concepts of restructuring; vertically integrated utilities; conditions leading to deregulation; benefits and challenges; market players—GENCO, TRANSCO, DISCO, consumers, system operator; independent system operator (ISO) and regulatory commissions; market architecture and models.	6	CO1 CO2
II	<b>Electricity Market Models and Pricing</b> Market structures: monopoly, oligopoly, pool markets, bilateral markets, hybrid models; auction types, bidding strategies; marginal cost of generation; locational marginal pricing (LMP); system lambda; price-based unit commitment; market clearing price (MCP).	10	CO2 CO3
III	<b>Transmission Congestion Management &amp; Pricing</b> Congestion causes and management techniques (rescheduling, redispatch, FACTS-based control); transmission rights—TTC, TRM, ATC; financial transmission rights (FTRs); MW-mile method, postage stamp and contract path methods; wheeling charges.	19	CO3 CO4
IV	<b>Ancillary Services, Risk, and Reliability Issues</b> Types of ancillary services—frequency regulation, spinning reserve, voltage support; procurement and pricing of ancillary services; market power—detection and mitigation; reliability management; demand response and its role in deregulated markets; regulatory and policy aspects.	10	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- Kankar Bhattacharya, Math H. J. Bollen and Jaap E. Daalder, Operation of Restructured Power Systems, Springer.
- L. L. Lai, Power System Restructuring and Deregulation, Wiley.
- Mohammad Shahidehpour and Muwaffaq Alomoush, Restructured Electric Power Systems: Operation, Trading, and Volatility, CRC Press.

**Reference Books:**

- Sally Hunt, *Making Competition Work in Electricity*, Wiley.
- Daniel Kirschen & G. Strbac, *Fundamentals of Power System Economics*, Wiley-IEEE Press.
- Shubhasis Mandal, *Introduction to Electricity Markets*, CRC Press.
- R. Baldick, *Electricity Market Reform: Theory, Implementation, and Best Practice*, Springer.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 411A	Power Electronics for EV applications	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To develop an in-depth understanding of advanced power converter topologies and their application in electric and hybrid vehicles.</li> <li>To analyze high-performance motor drives and control strategies for EV propulsion.</li> <li>To design energy-efficient and reliable charging and battery management systems.</li> <li>To explore next-generation power devices, multilevel converter architectures, and control integration for EV powertrains.</li> <li>To introduce modeling, simulation, and optimization of EV systems under real-world constraints.</li> </ol>	<b>Course Outcomes</b>	CO1	Understand advanced EV powertrain architectures and energy flow mechanisms.	Understanding / Comprehension					
			CO2	Design and analyze advanced DC–DC and DC–AC converter topologies for propulsion and charging applications.	Apply / Analyze					
			CO3	Implement motor control strategies for PMSM, SRM, and Induction Motor drives in traction systems.	Apply / Evaluate					
			CO4	Develop and evaluate BMS algorithms and high-power charging infrastructure in compliance with international standards.	Analyze / Evaluate					
			CO5	Explore emerging technologies including SiC/GaN devices, multilevel topologies, wireless charging, and V2G integration.	Understand / Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>EV Architecture and Powertrain Overview:</b> Classification of EVs (HEV, BEV, PHEV, FCEV); EV powertrain configurations; energy flow and losses; drive cycle analysis; control hierarchy and communication (CAN/LIN).	6	CO1 CO2
II	<b>Advanced Power Semiconductor Devices and Converters:</b> MOSFETs, IGBTs, SiC, GaN devices; high-frequency switching; efficiency, loss modelling, and thermal management; isolated and non-isolated DC–DC converters; interleaved and bidirectional converters; multilevel inverters (NPC, flying capacitor, cascaded H-bridge) for traction drives.	10	CO2 CO3
III	<b>Traction Motor Drives and Control Strategies:</b> PMSM, BLDC, SRM, and Induction Motor characteristics; FOC and DTC control methods; torque ripple minimization; regenerative braking control; real-time control implementation using DSP/FPGA. <b>Battery Systems and Energy Management:</b> Li-ion, solid-state, and hybrid energy storage; equivalent circuit modeling; BMS algorithms for SOC/SOH estimation; thermal management; cell balancing; DC link design; onboard/offboard charging systems; fast charging, wireless charging, and grid integration.	19	CO3 CO4
IV	<b>Charging Infrastructure and Emerging Trends:</b> Standards (CHAdeMO, CCS, Bharat EV, IEC 61851); V2G and V2H systems; smart charging control; EMI/EMC mitigation; SiC/GaN-based converter design case studies; simulation of EV systems using MATLAB/PLECS.	10	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Ali Emadi, *Advanced Electric Drive Vehicles*, CRC Press.
2. Muhammad H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, Pearson.
3. K. T. Chau, *Electric Vehicle Machines and Drives: Design, Analysis and Application*, Wiley.
4. Ned Mohan, *Power Electronics: Converters, Applications, and Design*, Wiley.
5. M. Ehsani, Y. Gao, A. Emadi, *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, CRC Press.

**Reference Books:**

1. Iqbal Husain, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press.
2. M. Ehsani, Y. Gao, A. Emadi, *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, CRC Press.
3. Tariq Muneer et al., *Electric Vehicles: Prospects and Challenges*, Elsevier.
4. J. G. Kassakian et al., *Principles of Power Electronics*, Pearson.
5. N. Mohan, *Electric Drives: An Integrative Approach*, MNPARE.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 411C	Energy Policy, Economics and Environmental Impacts	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. To understand global and national energy policies, regulatory frameworks, and energy governance. 2. To study economic principles governing energy pricing, demand–supply, and market structures. 3. To analyze environmental impacts of conventional and renewable energy systems. 4. To evaluate policy instruments, environmental regulations, and sustainable energy transitions. 5. To provide exposure to energy modelling, forecasting, and economic–environmental assessment tools.	<b>Course Outcomes</b>	CO1	Explain key concepts in energy policy, regulatory structures, and governance. Understand / Apply	Understanding / Comprehension					
			CO2	Analyze energy economics including pricing, cost–benefit, and market mechanisms. Apply / Analyze	Apply / Analyze					
			CO3	Evaluate environmental impacts of energy systems and mitigation strategies. Analyze / Evaluate	Apply / Evaluate					
			CO4	Assess policy instruments, international agreements, and sustainability frameworks. Evaluate	Analyze / Evaluate					
			CO5	Apply analytical tools for energy planning, forecasting, and environmental assessment. Apply / Create	Understand / Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	Introduction to Energy Policy and Governance: Energy policy fundamentals; national and global policy frameworks; energy security; regulatory bodies; energy access and sustainability.	6	CO1 CO2
II	Energy Economics and Market Principles: Energy demand–supply analysis; pricing mechanisms; externalities; subsidies; LCOE; economic dispatch; market structures and reforms.	10	CO2 CO3
III	Environmental Impacts of Energy Systems: Air and water pollution; GHG emissions; climate change; lifecycle assessment; EIA; pollution control technologies.	19	CO3 CO4
IV	Policy Instruments and Sustainability Approaches: Carbon pricing; emission trading schemes; RPO; CDM; SDGs; international agreements; clean energy transition pathways.	10	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. A. K. Bhattacharya, Energy Economics: Concepts, Issues and Policies, Springer.
2. J. T. Holladay, Energy Policy and the Environment, Elsevier.
3. I. Parry, Global Energy and Environmental Policy, Routledge.

**Reference Books:**

1. Vaclav Smil, Energy and Civilization: A History, MIT Press.
2. Lester Brown, Plan B: Mobilizing to Save Civilization, W.W. Norton.
3. Joseph Aldy & Robert Stavins, Post-Kyoto International Climate Policy, Cambridge University Press.
4. IPCC Reports on Climate Change and Energy Policy (selected chapters).



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 412A	Principles of Energy Conversion Systems	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	<ul style="list-style-type: none"> <li>Understand the fundamental principles of energy conversion and its significance in electrical engineering.</li> <li>Analyze electromechanical energy conversion principles in different energy systems.</li> <li>Study various energy sources, their conversion techniques, and efficiency considerations.</li> <li>Explore recent advancements and trends in energy conversion technologies.</li> </ul>	<b>Course Outcomes</b>	<b>CO1</b>	Explain the basic principles and significance of energy conversion.					Remembering		
			<b>CO2</b>	Analyze the working principles of electromechanical and thermal energy conversion.					Understanding		
			<b>CO3</b>	Apply energy conversion techniques to real-world applications and assess their efficiency.					Applying		
			<b>CO4</b>	Evaluate the advancements in energy conversion technologies and their impact on sustainability.					Evaluating		

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	Introduction to Energy Conversion: Basic principles, forms of energy, first and second laws of thermodynamics, efficiency of energy conversion systems.	<b>10</b>	<b>CO1, CO2</b>
<b>II</b>	Electromechanical Energy Conversion: Principles of magnetic circuits, force and torque in magnetic systems, energy storage in magnetic fields, rotating machines.	<b>12</b>	<b>CO2, CO3</b>
<b>III</b>	Thermal and Chemical Energy Conversion: Thermoelectric power generation, fuel cells, batteries, and their applications in energy storage.	<b>10</b>	<b>CO3, CO4</b>
<b>IV</b>	Renewable Energy Conversion: Solar, wind, hydro, and biomass energy conversion, efficiency and environmental impact, smart grids.	<b>13</b>	<b>CO3, CO4</b>
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. P.C. Sen, "Principles of Electric Machines and Power Electronics," John Wiley & Sons, 2013.
2. S. A. Nasar, "Electric Machines and Power Systems," McGraw Hill, 2002.
3. R. Krishnan, "Electric Motor Drives: Modeling, Analysis, and Control," Pearson, 2001.
4. M. J. Moran, H. N. Shapiro, "Fundamentals of Engineering Thermodynamics," Wiley, 2017.

**Reference Books:**

1. A. E. Fitzgerald, C. Kingsley, S. Umans, "Electric Machinery," McGraw-Hill, 2013.
2. G.D. Rai, "Non-Conventional Energy Sources," Khanna Publishers, 2011.
3. D.P. Kothari, I.J. Nagrath, "Power System Engineering," McGraw-Hill, 2019.
4. John Twidell, Tony Weir, "Renewable Energy Resources," Routledge, 2015.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	

EE – 412B	Special Electrical Machines	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To familiarize students with the construction, operation, and performance of special types of electrical machines.</li> <li>To study stepper, switched reluctance, and permanent magnet motors and their control strategies.</li> <li>To understand linear and brushless machines for modern industrial and traction applications.</li> <li>To analyze mathematical models and performance characteristics of special electrical machines.</li> <li>To introduce current trends in the use of special machines for EVs, robotics, and renewable systems.</li> </ol>	<b>Course Outcomes</b>	CO1	Understand the construction, principle, and classification of special electrical machines.	Understanding / Comprehension					
			CO2	Analyze the characteristics and control of stepper and switched reluctance motors.	Apply / Analyze					
			CO3	Develop mathematical models and control strategies for permanent magnet machines.	Apply / Create					
			CO4	Explain the working principles and applications of linear and brushless DC machines.	Analyze / Create					
			CO5	Examine the applications of special machines in electric vehicles, robotics, and renewable systems.	Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Special Machines:</b> Classification and significance of special electrical machines; advantages over conventional machines; basic concepts of torque production, excitation, and control methods. <b>Stepper Motors:</b> Construction, principle of operation, types (VR, PM, hybrid); torque-angle characteristics; static and dynamic performance; drive circuits; micro-stepping; applications in automation and robotics.	13	CO1
			CO2
II	<b>Switched Reluctance Motors (SRM):</b> Construction and principle; torque production mechanism; characteristics and control (current, voltage, and speed); converter topologies for SRM drives; advantages and limitations.	8	CO2
			CO3
III	<b>Permanent Magnet Machines:</b> PMDC, BLDC, and PMSM — construction, operation, emf and torque equations; vector control and sensor less operation; comparison with induction machines; control using DSP/FPGA platforms. <b>Linear Electrical Machines:</b> Linear induction motor (LIM), linear synchronous motor (LSM), and linear switched reluctance motor (LSRM); construction, performance equations, end effects, applications in traction and maglev.	17	CO3
			CO4
IV	<b>Modern Applications and Trends:</b> Special machines for EVs, aerospace, and renewable energy; torque ripple minimization; high-efficiency design; introduction to axial flux machines and bearing less drives.	7	CO3
			CO4
			CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

- E.G. Janardanan, *Special Electrical Machines*, PHI Learning Pvt. Ltd.
- K. Venkataratnam, *Special Electrical Machines*, Universities Press, 2014.
- T. J. E. Miller, *Brushless Permanent Magnet and Reluctance Motor Drives*, Clarendon Press.
- R. Krishnan, *Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications*, CRC Press.
- T. Kenjo and S. Nagamori, *Permanent Magnet and Brushless DC Motors*, Clarendon Press.

**Reference Books:**

- K. T. Chau, *Electric Vehicle Machines and Drives: Design, Analysis and Application*, Wiley.
- T. Kenjo and S. Nagamori, *Permanent Magnet and Brushless DC Motors*, Clarendon Press.
- D. Krishnan and A. Emadi, *Electric Drives: Modeling and Control*, CRC Press.
- J. F. Gieras, *Advancements in Electric Machines*, Springer.
- P. C. Sen, *Principles of Electric Machines and Power Electronics*, Wiley.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 413B	Smart and Micro Grid	3	0	0	3	20	30	50	100		

Course Objectives	Course Outcomes	CO1		CO2		CO3		Bloom's taxonomy
		Description	Assessment	Description	Assessment	Description	Assessment	
1. Apply advanced knowledge of electrical power system operations and control to analyze the challenges and opportunities due to increased penetration of renewable energy sources.  2. Understand and conceptualize the design of smart grid by selecting appropriate communication technologies, implementing smart meter and FACTS.  3. Describe the principles and requirements of the next generation future power network (or smart grid), using the latest trends in IoT for power systems.	CO1 CO2 CO3	to introduce the concept of smart grid		to discuss the future trends of power system industry.		Discussion on design of smart grid by selecting appropriate communication technologies, implementing smart meter and FACTS.		Understanding/Comprehension
								Understanding/Comprehension

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Evolution of Smart Grid Technology:</b> Introduction Indian smart grid policy. Basic concept and definition of smart grid. Smart grid architecture. Smart grid technologies. Properties of smart grid: flexibility, reliability, demand response and other performance parameters. DC smart micro grids.	10	CO1 CO2 CO3
II	<b>Different Technologies in Smart Grid:</b> standardization of communication protocols), Matrix of different technologies against the smart-grid communication needs in a given utility environment, AMI, AMR and MDA: How it works and how it will help to; reduce peaks manage networks more efficiently and contribute towards smarter grids, Communication Standards IEC6150, Wide Area Situation awareness (WASA), Network stability	10	CO1 CO2
III	<b>Data Management and Energy Monitoring:</b> Smart meters Introduction, technology, data management, energy monitoring, smart energy meter, Phasor Measurement Unit (PMU), smart metering infrastructure, data acquisition Flexible AC transmission system (FACTS) Congestion management and load ability enhancement, reactive power compensation, concept of series compensation, shunt compensation, FACTS: working principle, classification, series controllers, shunt controllers, series-series controllers, series-parallel controllers.	10	CO1 CO2
IV	<b>Smart Energy Management:</b> IoT for power systems Internet of things for electricity infrastructure and energy management. SCADA, Demand response, AMI, IoT aided smart grid, Big data for power system and introduction to data analytics. Application of smart grid Challenges being faced during implementation of smart grid. virtual power plants, Smart Utilities (case studies), Smart Grid Maturity Model (SGMM).	13	CO1 CO2 CO3
<b>Total Hours</b>		<b>43</b>	

**Text Books:**

1. 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

**Reference Books:**

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**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	

EE – 413B	Robotics and Control	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. Introduce the fundamentals of robotic systems, kinematics, dynamics, sensors, and actuators.</li> <li>2. Understand mathematical modelling of robot manipulators and mobile robots.</li> <li>3. Study control algorithms for motion planning, trajectory tracking, and stability.</li> <li>4. Apply modern methods for robot control, including nonlinear, PID, and advanced techniques.</li> <li>5. Provide exposure to simulation tools, case studies, and real-world robotic applications.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain the structure, components, and types of robotic systems.	Understanding/Comprehension					
			CO2	Analyze forward and inverse kinematics of robotic systems.	Apply / Analyze manipulators.					
			CO3	Evaluate robot dynamics, trajectory planning, and control algorithms.	Analyze / Evaluate					
			CO4	Apply classical and modern control strategies to manipulators and mobile robots.	Apply / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Introduction to Robotics</b> Evolution and classification of robots; components—links, joints, end-effector, workspace; robot anatomy; coordinate frames; transformations; DH parameters; applications in manufacturing, medical, and service robots.	10	CO1
			CO2
			CO3
<b>II</b>	<b>Kinematics of Robotic Manipulators</b> Forward kinematics, homogeneous transformations, DH modelling; inverse kinematics—geometric, algebraic, and numerical methods; singularities; Jacobian and velocity kinematics.	10	CO1
			CO2
<b>III</b>	<b>Control of Robotic Systems</b> PID control for robots; computed torque control; nonlinear control; adaptive control; sliding mode control; stability analysis using Lyapunov methods; control of mobile robots—kinematic model, feedback control, path tracking algorithms.	10	CO1
			CO2
<b>IV</b>	<b>Sensors, Actuators, and Simulation Tools</b> Actuators: DC/AC motors, stepper motors, servo motors; drives and power electronics; sensors: position, velocity, force/torque, vision, IMU; introduction to ROS, Gazebo, MATLAB/Simulink robotic toolbox; case studies of industrial and autonomous robots.	15	CO1
			CO2
			CO3
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. • Niku, S. B., *Introduction to Robotics: Analysis, Systems, Applications*, Wiley.
2. • Craig, J. J., *Introduction to Robotics: Mechanics and Control*, Pearson.
3. • Spong, M., Hutchinson, S., & Vidyasagar, M., *Robot Modeling and Control*, Wiley.

**Reference Books:**

1. Siciliano, B. & Khatib, O., *Springer Handbook of Robotics*, Springer.
2. Kelly, R., Santibañez, V., & Loria, A., *Control of Robot Manipulators in Joint Space*, Springer.
3. Corke, P., *Robotics, Vision and Control*, Springer.
4. Siegwart, R., Nourbakhsh, I., & Scaramuzza, D., *Introduction to Autonomous Mobile Robots*, MIT Press.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	
EE – 414B	Power Electronics for EV applications	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. To provide an in-depth understanding of the design process of electric vehicles (EVs) from system-level architecture to component selection.</li> <li>2. To enable students to design, model, and prototype a small-scale electric vehicle.</li> <li>3. To study the integration of mechanical, electrical, and control subsystems in EVs.</li> <li>4. To introduce the fundamentals of embedded systems and hardware used in EV control.</li> <li>5. To develop team-based prototyping and testing skills with an emphasis on real-world implementation.</li> </ol>	<b>Course Outcomes</b>	CO1	Understand the fundamental requirements, design parameters, and architecture of electric vehicles.	Understanding / Comprehension					
			CO2	Model and design sub-systems including traction motor, battery pack, and drivetrain.	Apply / Analyze					
			CO3	Design electronic control systems and embedded hardware for EV applications.	Apply / Create					
			CO4	Integrate mechanical and electrical systems for prototyping and testing of a small-scale EV.	Analyze / Create					
			CO5	Evaluate performance, safety, and reliability of designed EV prototypes using standard testing methods.	Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to EV Design:</b> Overview of EV systems; system-level design approach; specifications and performance goals; vehicle dynamics; load analysis; powertrain configuration; energy flow and efficiency mapping.	6	CO1 CO2
II	<b>Powertrain and Subsystem Design:</b> Motor selection (BLDC, PMSM, IM); gearbox and transmission design; torque-speed matching; battery sizing and pack configuration; BMS considerations; DC/DC and DC/AC converter interface design.	10	CO2 CO3
III	<b>Control Systems and Embedded Hardware:</b> Vehicle control unit (VCU) architecture; sensor integration (current, speed, temperature); embedded controller design using STM32/TI DSP; CAN communication; software-in-the-loop (SIL) and hardware-in-the-loop (HIL) simulation. <b>Mechanical Integration and Prototyping:</b> Chassis and suspension design basics; motor mounting; drivetrain coupling; wiring harness design; PCB fabrication for control circuits; 3D CAD modeling; safety isolation and enclosure design.	18	CO3 CO4
IV	<b>Testing, Validation, and Performance Evaluation:</b> Prototype testing; performance evaluation parameters (efficiency, range, acceleration); thermal management; regenerative braking test; compliance with AIS-038, IEC, and ISO safety standards.	11	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Ali Emadi, *Advanced Electric Drive Vehicles*, CRC Press.
2. Iqbal Husain, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press.
3. R. Krishnan, *Electric Motor Drives: Modeling, Analysis and Control*, Prentice Hall.
4. John Dixon, *Electric Vehicle Machines and Drives: Design, Analysis and Applications*, Wiley.
5. M. Ehsani, Y. Gao, A. Emadi, *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, CRC Press.

**Reference Books:**

1. James Larminie and John Lowry, *Electric Vehicle Technology Explained*, Wiley.
2. Tariq Muneer et al., *Electric Vehicles: Prospects and Challenges*, Elsevier.
3. J. G. Kassakian et al., *Principles of Power Electronics*, Pearson.
4. A. Emadi et al., *Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles*, CRC Press.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-28
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 415B	Load Forecasting	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. impart the knowledge of Industrial Electrical System. 2. enable the students to do analysis of different types of safety procedures for industry use. 3. make students capable of design and analyze the safety standards for industrial use	<b>Course Outcomes</b>	CO1	Able to understand the basic knowledge of basic safety audits and risk assessments					Understanding/Comprehension		
			CO2	Able to illustrate the electrical safety standards and implement preventive measures.					Understanding/Comprehension		
			CO3	Able to interpret and analyze the industrial electrical systems.					Identify/Knowledge/Remember		
			CO4	Able to understand and select suitable drives and automation systems for industrial use.					Understanding Analyzing		

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Industrial Electrical Systems Overview:</b> - Characteristics and classification of industrial loads, Industrial power supply systems: single-line diagrams, substation layout, Power distribution in industries — radial, ring, and interlocked systems, Types of earthing systems and their importance, Motor control centers (MCC), distribution boards, and panel design, Protection and control of motors (DOL, Star-Delta, VFDs, Soft Starters). Illumination systems in industries — design principles and energy-efficient lighting.	10	CO1 CO2 CO3
II	<b>Industrial Drives and Automation:</b> - Electric drives and control — selection criteria for industrial processes. Variable speed drives (AC/DC drives) and applications. PLCs and SCADA systems overview for industrial automation. Power factor correction in industrial installations.	11	CO2 CO3
III	<b>Electrical Safety and Standards:</b> - Causes of electrical accidents and preventive measures. Electric shock, arc flash, and short-circuit hazards. Safety devices — fuses, circuit breakers, relays, ELCBs, MCCBs, RCCBs. Personal protective equipment (PPE) for electrical work. Safety procedures — LOTO (Lock-Out/Tag-Out), grounding, insulation testing. Relevant standards: IS, IEC, IEEE, and Indian Electricity Rules.	13	CO3 CO4
IV	<b>Earthing, Lightning, and Power Quality:</b> - Purpose and methods of earthing — equipment and system earthing. Design of earthing system and measurement of earth resistance, Lightning protection — principles, components, and surge protection devices. Power quality issues — harmonics, voltage sags/swells, transients. Mitigation methods for power quality improvement.	11	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. S.L. Uppal & G.C. Garg, *Industrial Electrical Engineering and Automation*, Khanna Publishers. or any new updated version.
2. *Electrical wiring, Estimating and costing*, by K.B. Bhatia. 2008 or any new updated version of this book
3. T.S. Madhava Rao, *Industrial Safety Management*, Dhanpat Rai Publications.
4. B.L. Theraja & A.K. Theraja, *A Textbook of Electrical Technology, Vol. III – Industrial Applications and Illumination*, S. Chand..

**Reference Books:**

1. IEEE/IEC Standards on electrical safety and grounding. 2021
2. *Electric IS 732 – Code of Practice for Electrical Wiring Installations.*
3. IS 3043 – Code of Practice for Earthing.
4. R.K. Rajput, *Utilization of Electrical Energy*, Laxmi Publication (P) Ltd, Reprint 2006 or later



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-28
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 415B	Load Forecasting	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Introduce the fundamentals, need, and applications of load forecasting in modern power systems. 2. Study statistical, machine learning, and time-series methods for short-, medium-, and long-term forecasting. 3. Understand data preparation, feature engineering, uncertainty modeling, and performance evaluation. 4. Apply forecasting tools to renewable integration, smart grids, and demand response planning. 5. Provide exposure to software tools such as MATLAB/Python for practical implementation.	<b>Course Outcomes</b>	CO1	Explain the principles and importance of load forecasting in power system operation and planning.					Understanding/Comprehension	
			CO2	Apply classical and statistical forecasting techniques to model load patterns.					Understanding/Comprehension	
			CO3	Develop machine-learning and advanced forecasting models for different forecasting horizons.					Identify/Knowledge/Remember	
			CO4	Evaluate model performance using error metrics and uncertainty quantification techniques.					Understanding Analyzing	

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	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Introduction to Load Forecasting</b>	10	CO1
	Types of load forecasting: short-term, medium-term, and long-term; applications in power system operation, planning, scheduling, and energy markets; characteristics of load curves; factors affecting load—weather, socio-economic, seasonal, industrial trends; data requirements and challenges.		CO2
			CO3
<b>II</b>	<b>Classical &amp; Statistical Forecasting Techniques</b>	11	CO2
	Regression models, polynomial and exponential models; end-use and econometric models; AR, MA, ARMA models; time-series decomposition; smoothing techniques; calendar effects and temperature normalization; feature selection for classical models.		CO3
<b>III</b>	Machine Learning–Based Forecasting Methods Artificial Neural Networks (ANN); support vector regression (SVR); decision trees and random forests; k-NN models; feature engineering; data preprocessing; overfitting and regularization; model training and validation approaches.	13	CO3
			CO4
<b>IV</b>	<b>Advanced &amp; Deep Learning Forecasting Models</b>	11	CO2
	LSTM, GRU, RNN models for sequential load data; CNN-based forecasting; hybrid models (ARIMA–ANN, ANN–GA, etc.); probabilistic forecasting and uncertainty quantification; ensemble methods; scenario generation for renewable penetration.		CO3
			CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. H. L. Willis, *Spatial Electric Load Forecasting*, CRC Press.
2. S. Fan & L. Chen, *Electric Load Forecasting: Fundamentals and Best Practices*, Springer.
3. J. W. Taylor, *Short-Term Load Forecasting*, Elsevier.

**Reference Books:**

4. W. W.-S. Wei, *Time Series Analysis: Univariate and Multivariate Methods*, Pearson.
5. T. Hong & S. Fan, *Energy Forecasting: Models and Strategies*, Springer.
6. G. E. P. Box, *Time Series Analysis: Forecasting and Control*, Wiley.

7. A. Géron, *Hands-On Machine Learning with Python*, O'Reilly (for ML-based approaches).



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CURRICULUM

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VII

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 4101	High Voltage Engineering	3	0	0	3	20	30	50	100		
<b>Course Objectives</b>	1. provide knowledge of high voltage generation, measurement, and insulation coordination. 2. analyse different breakdown mechanisms in solid, liquid, and gaseous dielectrics. 3. understand high voltage testing techniques and standards. 4. introduce students to overvoltage phenomena and protection strategies.	<b>Course Outcomes</b>	CO1	Understand the basic concepts of high voltage generation and measurement.	Understanding						
			CO2	Analyze breakdown phenomena in various dielectrics.	Analyzing						
			CO3	Evaluate insulation coordination and testing techniques.	Evaluating						
			CO4	Propose protection methods against overvoltages.	Creating						

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to High Voltage Engineering:</b> Electric field stress, need for high voltage testing, applications of high voltage. <b>Generation of High Voltages:</b> AC, DC, impulse voltage generation, resonance testing.	12	CO1
II	<b>Breakdown Mechanisms:</b> Breakdown in gaseous dielectrics (Paschen's law, Townsend & Streamer theory), liquid dielectrics (electronic, cavitation, and thermal breakdown), solid dielectrics (intrinsic, electromechanical, and thermal breakdown).	11	CO2
III	<b>High Voltage Measurement:</b> Electrostatic voltmeters, sphere gap, peak voltmeters, digital techniques for high voltage measurement. <b>Insulation Coordination:</b> Basic insulation level, coordination of insulation strength, testing of insulators and transformers.	12	CO3
IV	<b>Overvoltage Phenomena &amp; Protection:</b> Switching surges, lightning phenomenon, insulation coordination, surge arresters, grounding techniques. <b>Testing of High Voltage Equipment:</b> Power frequency, impulse voltage testing of cables, insulators, transformers, and circuit breakers.	10	CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. M.S. Naidu & V. Kamaraju, High Voltage Engineering, McGraw Hill, 2015.
2. C.L. Wadhwa, High Voltage Engineering, New Age International, 2010.
3. E. Kuffel, W.S. Zaengl, J. Kuffel, High Voltage Engineering: Fundamentals, Elsevier, 2000.
4. Farouk A.M. Rizk & Giao N. Trinh, High Voltage Engineering, CRC Press, 2014.

**Reference Books:**

1. Ravindra Arora & Wolfgang Mosch, High Voltage Insulation Engineering, New Age Publishers, 2008.
2. Dieter Kind & Kurt Feser, High Voltage Test Techniques, Springer, 2001.
3. R.S. Jha, High Voltage Engineering, Dhanpat Rai, 2013.
4. M. Khalifa, High-Voltage Engineering: Theory and Practice, CRC Press, 2000.



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<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VIII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-420H	Sensors and Transducers	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. To introduce the fundamentals of robotics, kinematics, and dynamics. 2. To study actuators, sensors, and control methods used in robotic systems. 3. To analyze trajectory planning and motion control. 4. To understand applications of robotics in industry, automation, and intelligent systems.	<b>Course Outcomes</b>	CO1	Explain robot components, configurations, and applications.	Apply					
			CO2	Analyze forward and inverse kinematics of manipulators.	Analyze					
			CO3	Evaluate robot dynamics, actuators, and drive systems.	Apply, Create					
			CO4	Apply trajectory planning and feedback control for robotic motion.	Evaluate, Create					
			CO5	Analyze automation and intelligent robotic systems.	Apply, Evaluate					

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	CO1	3	2	2	1	1	1									
2	CO2	3	3	2	2	2	1									
3	CO3	3	3	3	3	2	1									
4	CO4	3	3	3	3	2	2									
5	CO5	2	3	3	3	3	2									
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Introduction to Robotics</b> Definition, history, and classification of robots; robotic components; coordinate frames; DOF; applications in manufacturing, automation, medical, and service sectors.	6	CO1
<b>II</b>	<b>Robot Kinematics</b> Forward and inverse kinematics; Denavit–Hartenberg (DH) parameters; homogeneous transformations; kinematic redundancy; Jacobians and singularities.	8	CO2
<b>III</b>	<b>Robot Dynamics and Actuators</b> Dynamics using Lagrange–Euler formulation; drive systems—DC, servo, stepper motors; hydraulic and pneumatic actuators; end effectors and grippers.	12	CO2
<b>IV</b>	<b>Robot Control and Trajectory Planning</b> Motion planning; point-to-point and continuous path control; PID and computed torque control; adaptive and robust control; force control; collision avoidance.	12	CO3
<b>V</b>	<b>Intelligent and Industrial Robotics</b> Robot sensors; vision systems; AI in robotics; autonomous robots; AGVs; industrial automation case studies.	7	CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. S. K. Saha, Introduction to Robotics, McGraw-Hill.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson.
3. Spong & Vidyasagar, Robot Modeling and Control, Wiley.
4. S. K. Saha, Introduction to Robotics, McGraw-Hill.

**Reference Books:**

5. Richard D. Klafter, *Robotic Engineering*, Prentice Hall.
6. R. Murphy, *Introduction to AI Robotics*, MIT Press.
7. Groover, *Industrial Robotics*, McGraw-Hill.
8. Siciliano & Khatib, *Springer Handbook of Robotics*, Springer.



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CURRICULUM

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	VIII

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-420H	Sensors and Transducers	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Provide advanced knowledge of state-space modeling and analysis of control systems. 2. Introduce modern techniques for stability and controller design. 3. Apply modern control theory to real-world systems and power electronics applications. 4. Enhance the ability to use computational tools (MATLAB/Simulink) for control analysis and design.	<b>Course Outcomes</b>	CO1	Develop state-space models of electrical and mechanical systems.						Apply
			CO2	Analyze controllability, observability, and stability of dynamic systems.						Analyze
			CO3	Design full-state feedback controllers and observers.						Apply, Create
			CO4	Evaluate system performance using modern control techniques such as pole placement and optimal control.						Evaluate, Create
			CO5	Implement state-space control models in MATLAB/Simulink for simulation and performance analysis.						Apply, Evaluate

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	CO1	3	2	2	1	1	1									
2	CO2	3	3	2	2	2	1									
3	CO3	3	3	3	3	2	1									
4	CO4	3	3	3	3	2	2									
5	CO5	2	3	3	3	3	2									
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Modern Control: Comparison between classical and modern control theories, State-space representation of linear systems, Advantages of state-variable approach, State transition matrix and solution of state equations.</b>	6	CO1
II	<b>System Analysis: Controllability and observability concepts, Canonical forms, Stability analysis using Lyapunov's direct method, Equilibrium points and system behavior.</b>	8	CO2
III	<b>Control System Design: Pole placement design using state feedback, Observer design and estimation, Design of control systems with integral action.</b>	8	CO2
IV	<b>Optimal Control: Performance indices and quadratic cost function, Linear Quadratic Regulator (LQR) design, Introduction to Linear Quadratic Gaussian (LQG) control.</b>	8	CO3
V	<b>Digital and Nonlinear Control Concepts: Discretization of continuous systems, State-space representation of discrete systems, Introduction to nonlinear systems and phase-plane analysis, Linearization and feedback linearization.</b>	7	CO4
VI	<b>Applications and Case Studies: Modern control applications in power electronics (DC-DC converters, drives), Use of MATLAB/Simulink for analysis and design.</b>	8	CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Ogata, K. *Modern Control Engineering*, Prentice Hall.
2. Dorf, R.C. and Bishop, R.H., *Modern Control Systems*, Pearson.
3. Nagrath, I.J., and Gopal, M., *Control Systems Engineering*, New Age International.

**Reference Books:**

1. Kailath, T., *Linear Systems*, Prentice Hall.
2. Brogan, W.L., *Modern Control Theory*, Pearson.
3. Chen, C.T., *Linear System Theory and Design*, Oxford University Press.
4. Gopal, M., *Modern Control System Theory*, New Age International.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	III

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE-210X	Fundamental of Circuit Analysis	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. Develop an understanding of fundamental circuit laws and network theorems. 2. Analyse AC and DC circuits using different methods. 3. Understand transient and steady-state responses of electrical circuits. 4. Apply two-port network theory and resonance concepts. 5. Introduce Laplace transform techniques for circuit analysis.	<b>Course Outcomes</b>	CO1	<b>Explain</b> and <b>apply</b> fundamental electrical laws, circuit components, and network theorems.	Understanding/Comprehension					
			CO2	Analyse DC and AC circuits using mesh, nodal, and network theorems.	Application/Analysis					
			CO3	<b>Examine</b> and <b>construct</b> transient and steady-state responses in RL, RC, and RLC circuits.	Application/Synthesis					
			CO4	<b>Evaluate</b> two-port network parameters and their interconnections for system design.	Analysis/Evaluation					
			CO5	<b>Apply</b> Laplace transform techniques to model and solve linear electrical circuits in the frequency domain.	Evaluation					

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	CO1	3	3	1	1	1							1			
2	CO2	3	3	2	2	2							1			
3	CO3	3	3	2	2	2							1			
4	CO4	3	3	3	2	3				1			2			
5	CO5	3	3	2	2	3				1			2			
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Basic Concepts and Circuit Laws:</b> Ohm's Law, Kirchoff's Laws, series and parallel circuits, star-delta transformation, source transformation.	7	CO1
II	<b>Network Theorems:</b> Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum Power Transfer theorem, Millman's theorem.	8	CO2
III	<b>AC Circuit Analysis:</b> Phasor representation, impedance, admittance, power and power factor, resonance in series and parallel circuits, Q-factor.	9	CO2
IV	Introduction to Graph Theory, Representation of Electrical Circuits as Graphs, Trees and Co-Trees, Network Matrices, Application to Circuit Analysis, Dual Networks, Topological Network Theorems, Practical Applications,	9	CO3
V	<b>Two-Port Networks:</b> Z, Y, h, and transmission parameters, interconnections of two-port networks, reciprocity and symmetry properties.	8	CO4
VI	<b>Laplace Transform and Applications:</b> Laplace transform of circuit elements, inverse transform, transfer function, frequency response analysis.	4	CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. William H. Hayt, Jack E. Kemmerly, *Engineering Circuit Analysis*, McGraw Hill, 2012.
2. A. Chakrabarti, *Circuit Theory (Analysis and Synthesis)*, Dhanpat Rai Publications, 2018.
3. M.E. Van Valkenburg, *Network Analysis*, Prentice Hall, 2010.

**Reference Books:**

1. Charles K. Alexander, Matthew N.O. Sadiku, *Fundamentals of Electric Circuits*, McGraw Hill, 2016.
2. John D. Ryder, *Networks, Lines, and Fields*, Prentice Hall, 2013.
3. Franklin F. Kuo, *Network Analysis and Synthesis*, Wiley, 2006.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	III

Course Code	Course Name (MAJOR-08-DSC3)	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	

EE-220X	Fundamentals of Linear Control Systems	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>To develop the ability to model and analyse linear time-invariant (LTI) control systems using mathematical representations such as differential equations, transfer functions, block diagrams, and state-space forms.</li> <li>To enable students to evaluate system performance in time and frequency domains and interpret system behavior using standard performance indices, stability criteria, and response characteristics.</li> <li>To impart skills in designing and tuning controllers and compensators (PID, lead, lag, and lead-lag) using classical methods such as root locus and frequency-response techniques.</li> <li>To introduce modern control concepts including state-space modelling, controllability, observability, and state-feedback design for improved system performance.</li> </ol>	<b>Course Outcomes</b>	<b>CO1</b>	Students will be able to model and represent linear time-invariant systems using transfer functions, block diagrams, and state-space methods.	Understanding/Comprehension					
			<b>CO2</b>	Students will be able to analyze the time-domain performance of first- and second-order systems and evaluate stability using classical criteria.	Application/Analysis					
			<b>CO3</b>	Students will be able to interpret and assess frequency-domain characteristics using Bode plots, Nyquist plots, and gain/phase margins.	Application/Synthesis					
			<b>CO4</b>	Students will be able to design and tune controllers and compensators (PID, lead, lag, and lead-lag) to meet specified performance requirements.	Analysis/Evaluation					
			<b>CO5</b>	Students will be able to apply state-space concepts—including controllability, observability, and state feedback—to analyze and improve system performance.	Evaluation					

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	CO1	3	3	1	1	1							1			
2	CO2	3	3	2	2	2							1			
3	CO3	3	3	2	2	2							1			
4	CO4	3	3	3	2	3					1		2			
5	CO5	3	3	2	2	3					1		2			
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	Introduction to control systems, open-loop and closed-loop systems, feedback principles, mathematical modeling of mechanical/electrical systems, block diagrams, signal-flow graphs, Mason's gain formula.	7	<b>CO1</b>
<b>II</b>	Time-domain analysis, standard test signals, transient and steady-state response, first- and second-order system responses, time-domain specifications, steady-state errors, error constants, Routh-Hurwitz stability criterion.	8	<b>CO2</b>
<b>III</b>	Frequency-domain analysis, frequency response concepts, Bode plots, gain and phase margins, bandwidth, Nyquist criterion, polar plots, Nichols chart, stability analysis.	9	<b>CO2</b>
<b>IV</b>	Control system components, potentiometers, tachogenerators, synchros, actuators (DC/AC servomotors, stepper motors), sensors, analog/digital controllers, state-variable modeling, transfer function-state space conversion.	7	<b>CO3</b>
<b>V</b>	Root locus concepts, rules and construction, stability determination, effect of poles and zeros, controller design using root locus, PID/PI/PD tuning, lead, lag, and lead-lag compensator design.	6	<b>CO4</b>
<b>VI</b>	State-space representation, state variables, state transition matrix, solution of state equations, controllability, observability, canonical forms, state feedback (pole placement), introduction to observers.	8	<b>CO5</b>
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. K. Ogata, *Modern Control Engineering*, Prentice Hall
2. B. C. Kuo, *Automatic Control Systems*, Wiley
3. N. S. Nise, *Control Systems Engineering*, Wiley
4. I. J. Nagrath & M. Gopal, *Control Systems Engineering*, New Age International Publishers

**Reference Books:**

1. Richard C. Dorf & Robert H. Bishop, *Modern Control Systems*, Pearson
2. Gene F. Franklin, J. David Powell & Abbas Emami-Naeini, *Feedback Control of Dynamic Systems*, Pearson
3. Chi-Tsong Chen, *Linear System Theory and Design*, Oxford University Press
4. Graham C. Goodwin, Stefan F. Graebe & Mario E. Salgado, *Control System Design*, Pearson



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	V

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	M ID	END	Total	

EE – 310X	Fundamentals of Power Electronics	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	<ol style="list-style-type: none"> <li>1. To introduce the basic principles and applications of power electronics to students from non-electrical backgrounds.</li> <li>2. To understand the operation and characteristics of power semiconductor devices.</li> <li>3. To study the conversion of electrical energy using different converter topologies.</li> <li>4. To explain the role of power electronics in renewable energy systems, electric vehicles, and automation.</li> <li>5. To provide hands-on exposure to simulation and practical understanding of converter behaviour.</li> </ol>	<b>Course Outcomes</b>	CO1	Explain the role and significance of power electronics in energy conversion and modern engineering systems.	Understanding / Comprehension					
			CO2	Describe the working principles of major power semiconductor devices and their switching characteristics.	Apply / Analyze					
			CO3	Analyze the operation of basic power converters: rectifiers, DC–DC converters, and inverters.	Apply / Evaluate					
			CO4	Apply power electronics concepts to practical systems such as renewable energy, drives, and consumer electronics.	Analyze / Evaluate					
			CO5	Use simulation tools to study converter performance and efficiency.	Understand / Evaluate / Create					

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	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Power Electronics:</b> Overview, applications, importance in modern systems; power flow and conversion principles; distinctions between electronics and power electronics. <b>Power Semiconductor Devices:</b> Diodes, SCRs, MOSFETs, IGBTs; static and dynamic characteristics; device ratings and selection; protection and thermal management.	13	CO1 CO2
II	<b>AC–DC Converters (Controlled and Uncontrolled Rectifiers):</b> Single-phase and three-phase rectifiers, half-and full-wave circuits; performance parameters (ripple, efficiency, THD); controlled rectifiers using SCRs.	8	CO2 CO3
III	<b>DC–DC Converters (Choppers):</b> Step-up (boost), step-down (buck), and buck-boost converters; principle of operation, switching waveforms, and applications.	8	CO3 CO4
IV	<b>DC–AC Converters (Inverters):</b> Basic operation of single-phase and three-phase inverters; PWM techniques; voltage and frequency control; applications in UPS and solar systems. <b>Applications and Simulations:</b> Applications in renewable energy, electric vehicles, and household devices; introduction to MATLAB/Simulink-based simulation of converters.	16	CO3 CO4 CO5
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. M. H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, Pearson.
2. N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
3. P. S. Bimbhra, *Power Electronics*, Khanna Publishers.
4. V. Subrahmanyam, *Power Electronics – Devices, Circuits and Industrial Applications*, New Age International.

**Reference Books:**

1. B. K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
2. R. Krishnan, *Electric Motor Drives: Modeling, Analysis, and Control*, Prentice Hall.
3. Fang Lin Luo and Hong Ye, *Fundamentals of DC–DC Converters*, CRC Press.
4. Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
5. P. C. Sen, *Power Electronics*, Tata McGraw-Hill.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2024-25
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 320X	Fundamentals of Power Systems	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. impart the knowledge of generation of electricity based on conventional and non-conventional sources 2. enable the students to do analysis of different types of distribution systems and its design 3. make students capable of analysis of mechanical and electrical design aspects of transmission system	<b>Course Outcomes</b>	CO1	Able to understand the basic structure of power generation, transmission and distribution.						Understanding/Comprehension
			CO2	Able to illustrate the various concept and importance of prominent power generation system and its transmission.						Understanding/Comprehension
			CO3	Able to describe the structure of power system, and its various phenomenon, and parameters of transmission line.						Identify/Knowledge/Remember
			CO4	Able to interpret and analyze the mechanical design of overhead transmission line.						Understanding Analyzing

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
I	<b>Introduction to Power System:</b> Basic description of Power, current, voltage and frequency, Brief introduction of Power generation system, including Thermal, Hydro, Nuclear and brief description of non-conventional power plants. Merits, Demerits and site selections of the above power plants. Transmissions and distribution of power three-wire four-wire system and service connections	12	CO1 CO2 CO3
II	<b>Power Generation:</b> Brief introduction of Power generation system, including Thermal, Hydro, Nuclear and brief description of non-conventional power plants. Merits, Demerits and site selections of the above power plants concept of GMD and self-GMD. Bundle conductor, Skin and proximity effect.	12	CO2 CO3
III	<b>Mechanical design Transmission Lines:</b> Typical Electric pole, Sag, Types of insulators, Potential distribution over a string of suspension insulators, T and HT poles, Pole vs Towers.	10	CO3 CO4
IV	<b>Power system protection and Domestic connection:</b> Instruction of power system protection, protection of line, transformer, household, CBs, Isolators, lightning arresters. Earthing and neutral line. Transmissions and distribution of power three-wire four-wire system and service connections.	11	CO2 CO3 CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 2011.
2. Harder Edwin.I, "Fundamentals of Energy Production", John Wiley and Sons, 2008.
3. Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Ald 1979
4. Wadhwa, C.L., "Electric Power Systems", 6<sup>th</sup> Edition, Wiley Eastern Limited, 2018.
5. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995

**Reference Books:**

1. Electric Transmission and Distribution Reference Book", Westing house Electric Corporation: East Pittsburg, Pa, 1964.
2. Burke James, J., "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekk., 1996.
3. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Edition, 2008.



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**CURRICULUM**

<b>Programme</b>	Bachelor of Technology in Electrical Engineering	<b>Academic Year of Regulation</b>	2025-26
<b>Department</b>	Electrical Engineering	<b>Semester</b>	IV

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 410X	Fundamentals of Electrical Machines	3	0	0	3	20	30	50	100	
<b>Course Objectives</b>	1. acquire knowledge about the fundamental principles and classification of electromagnetic machines. 2. acquire knowledge about the constructional details and principle of operation of dc machines. 3. acquire knowledge about the working of dc machines as generators and motors. 4. acquire knowledge about the constructional details, principle of operation, testing and applications of transformers.	<b>Course Outcomes</b>	CO1	Able to understand the basic structure of various types of machines used like DC and AC machines and Transformer.						Understanding/Comprehension
			CO2	Able to illustrate the working principle and different types of DC and AC machines.						Understanding/Comprehension
			CO3	Able to illustrate the constructional features and different types of DC and AC machines as generators and motors.						Identify/Knowledge/Remember
			CO4	Able to illustrate the constructional features and different types of Transformers.						Understanding Analyzing

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	CO1															
2	CO2															
3	CO3															
4	CO4															
<b>(Average)</b>																

**SYLLABUS**

No.	Content	Hours	COs
<b>I</b>	<b>Principles of Electromechanical Energy Conversion</b> Magnetic circuits; hysteresis and eddy current losses; electromagnetic induction; electromechanical energy conversion principles; force and torque production; rotating magnetic fields.	10	CO1
			CO2
			CO3
<b>II</b>	<b>Transformers</b> Construction and working; EMF equation; ideal and practical transformer; equivalent circuit; phasor diagrams; voltage regulation and efficiency; OC and SC tests; auto-transformers; three-phase transformers; applications.	10	CO2
			CO3
<b>III</b>	<b>DC Machines</b> Construction and types; armature reaction; commutation; EMF and torque equations; characteristics of DC generators and motors; starting and speed control; losses and efficiency; testing of DC machines.	10	CO3
			CO4
<b>IV</b>	<b>Induction Machines</b> Three-phase induction motor construction and operation; slip and torque characteristics; equivalent circuit; circle diagram; starting and speed control; induction generator basics; single-phase induction motor types and characteristics.  <b>Synchronous Machines</b> Construction and operation; EMF equation; synchronous reactance; phasor diagrams; voltage regulation; power-angle characteristics; synchronous motor operation; starting methods; V-curves.	15	CO2
			CO3
			CO4
<b>Total Hours</b>		<b>45</b>	

**Text Books:**

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.

**Reference Books:**

1. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
2. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
3. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.