GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
(An Autonomous Institute of Government of Maharashtra)

Curriculum Structure for
B. Tech. Electrical Engineering Programme

(In light of NEP 2020)

NCrF Level 6
(NEP_Version II)

For students admitted in 2023-24 onwards

Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)
Near Kathora Naka, Amravati, Maharashtra
PIN 444604
www.gcoea.ac.in

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GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
(An Autonomous Institute of Government of Maharashtra)
Structure for B. Tech. Programme in light of NEP 2020

For students admitted in 2023-24 onwards

Key Features of Curriculum

1. Multiple entry and exit option after every year.
2. Provision for Open Electives (OE), Vocational and Skill Enhancement Courses (VSE), Ability Enhancement Courses (AE), Indian Knowledge System (IKS), Value Education Courses (VE), Co-Curricular Courses (CC) in addition to program core courses.
3. Mandatory internship of one semester.
4. Credits for Value education courses, Ability Enhancement Courses, Co-Curricular Curricular Activities.
5. Mandatory Non-Credit Courses.
6. Interdisciplinary and multidisciplinary education through single and double minors and open electives.
7. Skill based courses and multiple exit level.
8. Provision for learning in online mode through Swayam / NPTEL etc. courses
9. Provision for B.Tech. Honours with Research degree through research project.
10. Opportunity for learner to choose courses of their interest in all disciplines.
11. Provision of Skill Based Courses and internship/Field project/mini projects for exit options at each level.
12. Flexibility for all types of learners i.e. Good, Normal and Exit

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Good Students	Normal Students	Exit
B. Tech. Major with Multidisciplinary Minor	B. Tech. Major with Multidisciplinary Minor	Additional 08 credits in the form of skill-based courses / labs, internship, mini projects shall be offered in 8 weeks.
B. Tech. Honors and Multidisciplinary Minor	--	
B. Tech. Honors with Research and Multidisciplinary Minor	--	
B. Tech. with Double Minor (Multidisciplinary and Specialization Minor)	--	

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Credit Distribution for each year and Exit Option

NCrFLevel	Year / Semester	Exit Option	Credits	Additional Credits for exit students	Total Credits
4.5	Semester I & II	U. G. Certificate	43	08	51
5.0	Semester III & IV	U. G. Diploma	83	08	91
5.5	Semester V & VI	B. Vocational/B.Sc. Engg.	128	08	136
6.0	Semester VII & VIII	B. Tech. Major with Multidisciplinary Minor	167	--	167
		B. Tech. Honors and Multidisciplinary Minor	167+18=185	--	185
		B. Tech. Honors with Research and Multidisciplinary Minor	167+18=185	--	185
		B. Tech. with Double Minor (Multidisciplinary and Specialization Minor)	167+18=185	--	185

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Course Category-wise Credit Distribution

Course Category	As per NEP GR	GCOEA Credits	CC	As per NEP GR	GCOEA Credits
BSC/ESC	30	30	BS	14-18	18
			ES	16-12	12
Program Courses	64-76	67	PC	44-56	47
			PE	20	20
Multidisciplinary Courses	22	22	MM	14	14
			OE	8	8
Skill Courses	8	8	VSE	8	8
Humanities, Social Science & Management (HSSM)	14	14	AE	4	4
			EM	4	4
			IKS	2	2
			VE	4	4
Experiential Courses	22	22	RM	4	4
			FP	2	2
			PR	4	4
			IN/OJT	12	12
Liberal Learning Courses	4	4	CC	4	4
Total Credits	**160-176**	**167**		**160-176**	**167**

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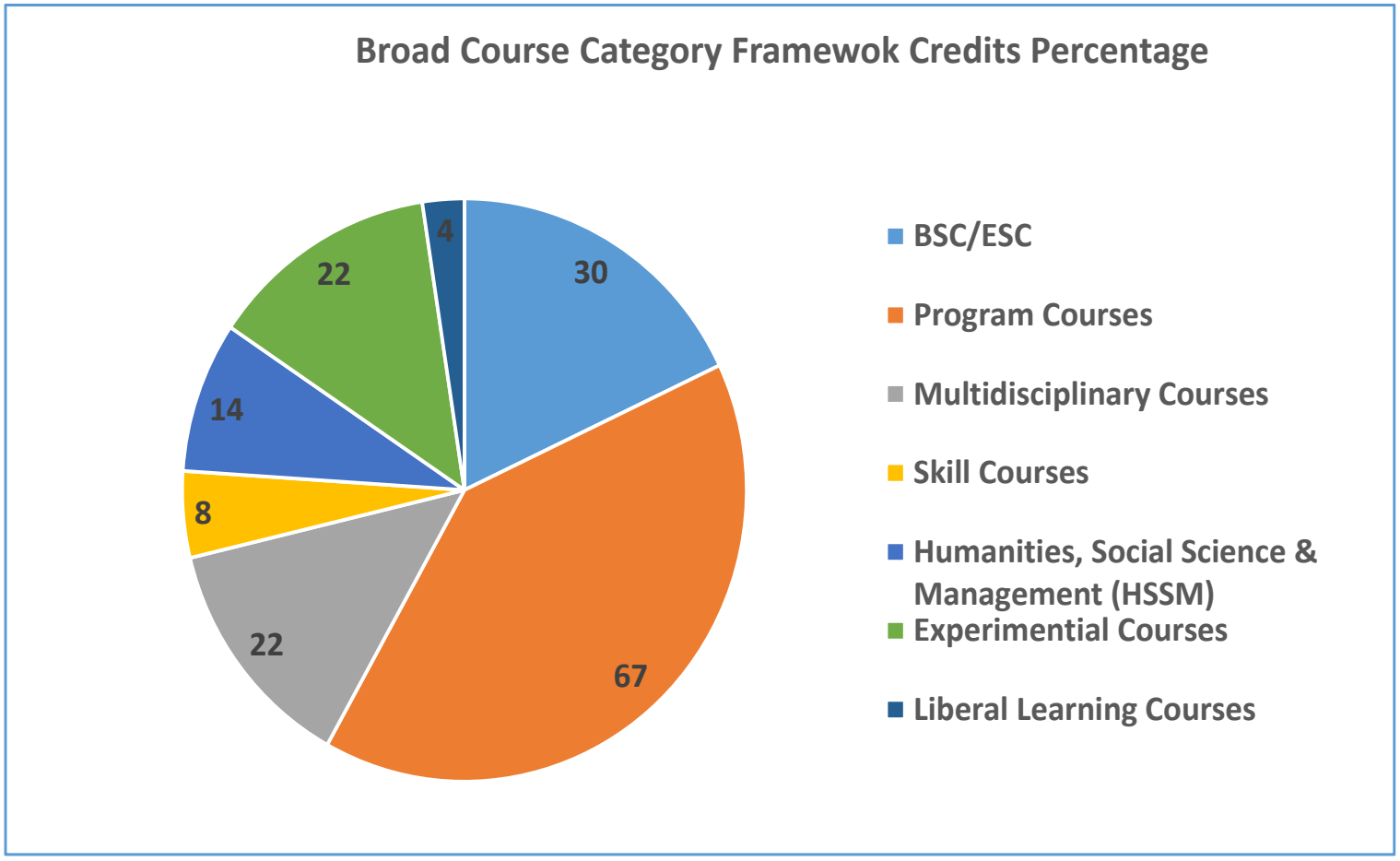

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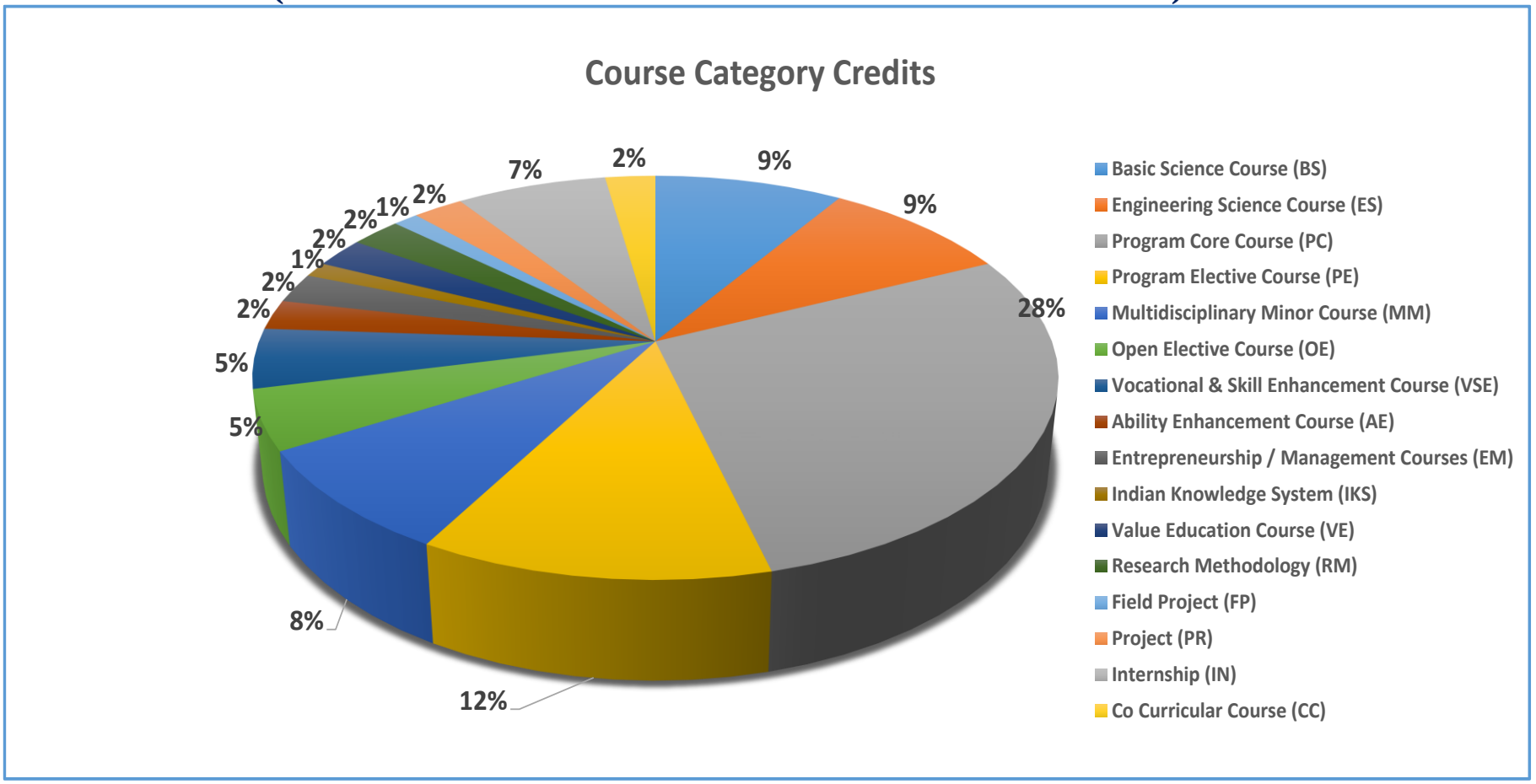

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Semester-wise Credit Distribution

Sr. No.	SEM	I	II	III	IV	V	VI	VII	VIII	Total Credits	NEP Requirement
1	Basic Science Course (BS)	8	7	3						18	14-18
2	Engineering Science Course (ES)	8	4							12	12-16
3	Program Core Course (PC)		6	10	11	11	6	3		47	44-56
4	Program Elective Course (PE)					4	8	8		20	20
5	Multidisciplinary Minor Course (MM)			3	3	3	3	2		14	14
6	Open Elective Course (OE)				3	3		2		8	8
7	Vocational & Skill Enhancement Course (VSE)			3	1	2	1	1		8	8
8	Ability Enhancement Course (AE)	1	3							4	4
9	Entrepreneurship / Management Courses (EM)			1					3	4	4
10	Indian Knowledge System (IKS)	2								2	2
11	Value Education Course (VE)	2	2							4	4
12	Research Methodology (RM)								4	4	4
13	Field Project (FP)						2			2	2
14	Project (PR)							4		4	4
15	Internship (IN)								12	12	12
16	Co Curricular Course (CC)				2	2				4	4
	Total Credits	**21**	**22**	**20**	**20**	**25**	**20**	**20**	**19**	**167**	160-176

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General Instructions:

(1) 10% content of syllabus of each theory course shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

(2) Student can complete **any Course** or programme elective courses PE1 to PE5 in "online" mode, offered through SWAYAM/ NPTEL portal or equivalent platform which provides Evaluation mechanism with the permission of Departmental Faculty Board (DFB). In this case –

(i) Students can register and complete these online courses any time after beginning of third semester, however, the student must successfully complete and pass the course, and submit the score card/certificate before declaration of result of respective semester in which the course is being offered.

(ii) In case, if a student registers for a course in online mode but fails in the course, the student will have to register for the course offered by the institute in respective semester as per curriculum. In this case, the student will have to appear for all the examinations (CT1/CT2, TA, ICA, ESE etc.) of the course, and successfully complete the course.

(3) In eighth semester, the students have to complete mandatory internship of one semester in the company/ organization approved by the DFB.

(4) In eighth semester during internship, the students have to complete the theory courses in any one of the two modes:

(i) **Online courses** offered through SWAYAM/ NPTEL or equivalent platform which provides Evaluation mechanism with the permission of DFB: In this case, students can register and complete these online courses any time after beginning of third semester and complete the course and submit the score card/ certificate before declaration of result of eighth semester.

In case if a student registers for a course in online mode but fails in the course, the student will have to register for the course offered by the institute as per curriculum. In this case, the student will have to appear for all the examinations (CT1/CT2, TA, ICA, ESE etc.) of the course personally as per the schedule declared by the institute, and successfully complete the course.

(ii) **Self-study mode:** In this case the student will have to study the course offered by the institute of his/her own. The student shall appear for all the college assessments/ examinations (CT1/CT2, TA and ESE) personally as per the schedule declared by the institute and successfully complete the course.

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(5) In addition to program specific courses, the students have to complete vocational skill courses, internship, field projects connected to **major degree**.

(6) Exit Option:

The exit option at the end of each year will be available to students after even semester. i.e. 2nd semester, 4th semester & 6th semester and will commence from AY 2024-25 for UG Certificate, AY 2025-26 for UG Diploma, AY 2026-27 for B. Voc./B. Sc. Engineering degree.

(7) Students opting for exit at any level (after odd semesters or even semester) will have to earn additional eight credits before exit in skill based vocational courses and internship/apprenticeship/mini project to make them eligible to get UG certificate / UG Diploma or B. Voc. /B. Sc. Engineering degree as per eligibility.

(8) Re Entry and Lateral Entry: Students opting for exit at any level after even semester, will have the option to re-enter the programme from where they left off in odd semesters within **four years of exit.** There shall be a gap of at least **one year** between exit and re-entry to UG programme.

(9) Students opting for exit after odd semester, i.e. 1st, 3rd, 5th or 7th semester will have the option to re-enter the programme from where they left off in even semesters only. There shall be a gap of at least **one year** between exit and re-entry to UG programme.

(10) Maximum period for completion of B. Tech. programme:

The student has to complete the degree programme within the stipulated **maximum period of eight years** from the date of admission to first year UG. The maximum duration of the programme includes the period of exit, withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute. However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by **additional one year**.

(11) Eligibility for admission to the UG Bachelor's Degree with Honours/ Research/Double Minor:

Students with minimum **CGPA of 7.5** without backlog courses at the end of fourth semester and should have earned **84 credits** are eligible for admission to the UG Bachelor's Degree with Honours/ Research/ Double Minor.

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Multiple exits: Following options are available for multiple exists:

Option	NCrF Level	Qualification Title	Additional credit requirement	Bridge courses
Exit-1	4.5	One Yr. UG certificate course in Engg./Tech.	8	2 Months Internship **OR** Online Two skill courses at ITI Level from NSQF/ESSC/ANY Other agency which provides certification/ Evaluation @ (**Electrical Measurement and Wiring & Maintenance and Repairs of Electrical Equipment**) **OR** Technical Project
Exit-2	5.0	Two Yr. UG Diploma in Engg./Tech.	8	2 Months Internship **OR** Online Two skill courses at Diploma Level from NSQF/ESSC/ANY Other agency which provides certification/ Evaluation @ (**Industrial Automation & Electrical Estimating and Costing**) **OR** Technical Project
Exit-3	5.5	Three Yr. Bachelor Degree in Vocation. (B.Voc.) or B.Sc. (Engg./Tech.)	8	2 Months Internship **OR** Online Two skill courses at Degree Level from NSQF/ESSC/ANY Other agency which provides certification/ Evaluation @ (**Solar & LED Technician & EV Charging Station Technician**) OR Technical Project

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SEMESTER –III														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
											Practical		**Total**	
			TH	TU	PR	Total	CT-1	CT-2	TA	ESE	ICA	ESE		
BS5	SH1301(C)	Transform and Differential Equations	3			3	15	15	10	60			100	3
MM1	EE1315/ EE1316	Multidisciplinary Minor 1	3			3	15	15	10	60			100	3
PC3	EE1301	Electromagnetic Fields	4			4	15	15	10	60			100	4
PC4	EE1302	Electrical Circuit Analysis	3			3	15	15	10	60			100	3
PC5	EE1303	Signals & Systems	3			3	15	15	10	60			100	3
VSE1	EE1304	Electrical Circuit Analysis Laboratory			2	2					25	25	50	1
VSE2	EE1305	Electrical Measurements and Measuring Instruments Laboratory	1		2	3					25	25	50	2
EM1	EE1310	Idea Laboratory			2	2					50		50	1
Total			**16**	**1**	**6**	**23**	**75**	**75**	**50**	**300**	**100**	**50**	**650**	**20**

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SEMESTER – IV														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM2	EE1415/ EE1416	Multidisciplinary Minor 2	3			3	15	15	10	60			100	3
PC6	EE1401	Electrical Machines – I	3			3	15	15	10	60			100	3
PC7	EE1402	Microprocessors and Microcontrollers	3			3	15	15	10	60			100	3
PC8	EE1403	Power Electronics	3			3	15	15	10	60			100	3
OE1	SH1401	Open Elective 1	3			3	15	15	10	60			100	3
PC9	EE1404	Electrical Machines - I Laboratory			2	2					25	25	50	1
PC10	EE1405	Microprocessors and Microcontrollers Laboratory			2	2					25	25	50	1
VSE3	EE1406	Power Electronics Laboratory			2	2					25	25	50	1
CC1	SH1402	Co-curricular Course			4	4			20				20	2
Total			**15**	**0**	**10**	**25**	**75**	**75**	**70**	**300**	**75**	**75**	**670**	**20**

Co-Curricular Course: Active Participation in Activities such as: Heath and wellness, Sports, Yoga education ,Tech-fest, College Club Activity, University level/ college level cultural activities, Drama, painting, Fine/applied/visual performing arts, Annual day, Department student's association/IE/ISTE/Any professional body, Paper presentation, Foreign language certificate, NCC, NSS etc. **Co-Curricular Course Activities minimum hours:** 2 hours per week or 24 hours.

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EXIT CRITERIA FOR U. G. DIPLOMA														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
EX2	EE1411	**Industrial Automation**			08	08					50		50	4
EX2	EE1412	**Electrical Estimating and Costing**			08	08					50		50	4
OR														
EX2	EE1413	**Internship / Technical Project**			16	16					100@		100	8

@ Based on seminar, Internship Report, Internship/ Project evaluation

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SEMESTER –V														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
								Theory			Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM3	EE1515/ EE1516	Multidisciplinary Minor 3	3			3	15	15	10	60			100	3
PC11	EE1501	Electrical Power - I	3			3	15	15	10	60			100	3
PC12	EE1502	Electrical Machines – II	3			3	15	15	10	60			100	3
PC13	EE1503	Control System	3			3	15	15	10	60			100	3
PE1	EE1504	Program Elective 1	4			4	15	15	10	60			100	4
OE2	SH1501	Open Elective 2	3			3	15	15	10	60			100	3
VSE4	EE1505	Professional Software Lab			2	2					25	25	50	1
VSE5	EE1506	Electrical Power – I Laboratory			2	2					25	25	50	1
PC14	EE1507	Electrical Machines – II Laboratory			2	2					25	25	50	1
PC15	EE1508	Control System Laboratory			2	2					25	25	50	1
CC2	SH1502	Co-curricular Course			4	4			20				20	2
MNC2	SH1503	Soft Skills	2			2			20				20	0
Total			**21**	**0**	**10**	**31**	**90**	**90**	**100**	**360**	**100**	**100**	**840**	**25**

Co-Curricular Course: Active Participation in Activities such as: Heath and wellness, Sports, Yoga education ,Tech-fest, College Club Activity, University level/ college level cultural activities, Drama, painting, Fine/applied/visual performing arts, Annual day, Department student's association/IE/ISTE/Any professional body, Paper presentation, Foreign language certificate, NCC, NSS etc. **Co-Curricular Course Activities minimum hours:** 2 hours per week or 24 hours.

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ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH1	EE1521	Digital Signal Processing (NPTEL, IIT Bombay, Prof. V. M. Gadre)	03			03	15	15	10	60			100	3
PEH2	EE1522	Operation and Planning of Power Distribution Systems (NPTEL, IIT Guwahati, Dr. Sanjib Ganguly)	03			03	15	15	10	60			100	3
	Total		06			06	30	30	20	120			200	**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER1	EE1531	Research Project Stage 1			08	08					100		100	4
Total					08	08					100		100	4

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (Electrical Engineering) for other branch students														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN1	EE1541	Network Analysis	3			3	15	15	10	60			100	3
MN2	EE1542	Electrical Machines	3			3	15	15	10	60			100	3
	Total		6			6	30	30	20	120			200	6

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SEMESTER –VI														
Category	**Course Code**	**Name of the Course**	**Teaching Scheme**				**Evaluation Scheme**							**Credits**
							Theory				**Practical**		**Total**	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM4	EE1615/ EE1616	Multidisciplinary Minor 4	3			3	15	15	10	60			100	3
PC16	EE1601	Electrical Power - II	3			3	15	15	10	60			100	3
PC17	EE1602	Control System Design	3			3	15	15	10	60			100	3
PE2	EE1603	Program Elective 2	4			4	15	15	10	60			100	4
PE3	EE1604	Program Elective 3	3	1		4	15	15	10	60			100	4
VSE6	EE1605	Electrical Power – II Laboratory			2	2					25	25	50	1
FP	EE1606	Minor Project			4	4					25	25	50	2
MNC3	EE1607	Electrical Estimation and Costing	2			2	15	15	20				50	0
MNC4	SH1601	NCC/NSS/Community service etc.							20				20	0
Total			**17**	**2**	**6**	**25**	**90**	**90**	**90**	**300**	**50**	**50**	**670**	**20**

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EXIT CRITERIA FOR EXIT CRITERIA FOR B. VOC.															
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme								Credits
							Theory				Practical		Total		
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE			
EX3	EE1611	**Solar & LED Technician**			08	08					50		50		4
EX3	EE1612	**EV Charging Station Technician**			08	08					50		50		4
OR															
EX3	EE1613	**Internship / Technical Project**			16	16					100@		100		8

@ Based on seminar, Internship Report, Internship/ Project evaluation

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ADDITIONAL CRITERIA FOR HONORS														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH3	EE1621	Transmission Lines and Electromagnetic Waves (NPTEL IIT Madras, Ananth Krishnan)	3			3	15	15	10	60			100	3
PEH4	EE1622	Industrial Automation and Controls (IIT Kharagpur, Alok Kanti Deb)	3			3	15	15	10	60			100	3
	Total		6			6	30	30	20	120			200	**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER2	EE1631	Research Project Stage 2			12	12					100	100	200	6
Total					12	12					100	100	200	6

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ADDITIONAL CRITERIA FOR DOUBLE MINOR (Electrical Engineering) for other branch students														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			Theory Hrs /week	Tutorial Hrs/week	Practical Hrs/week	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN3	EE1641	Electrical Power	3			3	15	15	10	60			100	3
MN4	EE1642	Power Electronics	3			3	15	15	10	60			100	3
	Total		6			6	30	30	20	120			200	6

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SEMESTER –VII														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MM5	EE1715/ EE1716	Multidisciplinary Minor 5			4	4					100		100	2
PC18	EE1701	Electrical Drives and Control	3			3	15	15	10	60			100	3
PE4	EE1702	Program Elective 4	3	1		4	15	15	10	60			100	4
PE5	EE1703	Program Elective 5	4			4	15	15	10	60			100	4
OE3	SH1701	Open Elective 3	2			2	15	15	10	60			100	2
VSE7	EE1704	Electrical Drives and Control Laboratory			2	2					25	25	50	1
PR	EE1705	Project			8	8					50	50	100	4
MNC 5	EE1706	Electrical Power Utilization & Safety	2			2	15	15	20				50	0
Total			**14**	**1**	**14**	**29**	**75**	**75**	**60**	**240**	**175**	**75**	**700**	**20**

Note: Project Guide Teaching load: 8hrs/week.

Students can register for the elective in seventh semester under Multidisciplinary Minor 4 using **SWAYAM/NPTEL** etc. portal. Courses will be of completely student's choice but approved by DFB of concerned department (other than MM1 to MM3) and should be **at least of 12 weeks** including tutorials, which will be considered as **4 credit course**.

Students can register and complete online courses for Multidisciplinary Minor 4any time after completion of semester IV, however, the student must successfully complete and pass the course, and submit the score card/certificate before declaration of result of VII semester.

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ADDITIONAL CRITERIA FOR HONORS

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PEH5	EE1721	Digital Control Systems (NPTEL, IIT Guwahati, Indrani Kar)	3			3	15	15	10	60			100	3
PEH6	EE1722	Power Quality (NPTEL, IIT Delhi, Bhim Singh)	3			3	15	15	10	60			100	3
	Total		6			6	30	30	20	120			200	**6**

ADDITIONAL CRITERIA FOR HONORS WITH RESEARCH

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
PER3	EE1731	Research Project Stage 3			16	16					100	200	300	8
Total					16	16					100	200	300	8

ADITIONAL CRITERIA FOR DOUBLE MINOR (Electrical Engineering) for other branch students

Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
							Theory				Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE		
MN5	EE1741	Control Systems	3			3	15	15	10	60			100	3
MN6	EE1742	Electrical Drives and Control	3			3	15	15	10	60			100	3
	Total		6			6	30	30	20	120			200	6

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SEMESTER –VIII														
Category	Course Code	Name of the Course	Teaching Scheme				Evaluation Scheme							Credits
								Theory			Practical		Total	
			TH	TU	PR	Total	CT1	CT2	TA	ESE	ICA	ESE	Total	
RM	SH1801	Research Methodology (Online through SWAYAM/NPTEL)	4			4	15	15	10	60			100	4
EM2	EE1801	Principles of Management (Online through NPTEL, IIT Roorkee, Prof. Usha Lenka) https://onlinecourses.nptel.ac.in/noc23_mg33/preview	3			3	15	15	10	60			100	3
IN	EE1802	Internship (Online reviews - one in each month)									100	200	300	12
		Total	7			7	30	30	20	120	100	200	500	19

Note: Internship Guide Teaching load: 4 hrs/week.

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LIST OF PROGRAM ELECTIVES					
	PE1-EE1504	**PE2-EE1603**	**PE3-EE1604**	**PE4-EE1702**	**PE5-EE1703**
A	Electrical Machine Design	Power System Protection	EHV AC Transmission	HVDC and FACTS	Power System Dynamics and Stability
B	Energy Efficiency in Electrical Utilities	Energy Resources, Environment and Economics	Introduction to Renewable Energy	Power Generation and Systems Planning	Energy Management
C	Electric and Hybrid Electric Vehicles	EV Battery and Chargers	EV Motors and Power Converters	Super Capacitors and Fuel Cell Technology	Electric Vehicles: Design, Dynamics & Testing
	SWAYAM/NPTEL etc. related to vertical approved by DFB	**SWAYAM/NPTEL** etc. related to vertical approved by DFB	**SWAYAM/NPTEL** etc. related to vertical approved by DFB	**SWAYAM/NPTEL** etc. related to vertical approved by DFB	**SWAYAM/NPTEL** etc. related to vertical approved by DFB

SWAYAM/ NPTEL etc. portal Courses for PE1 to PE5 should be related to concerned vertical approved by DFB and should be at least of **12 weeks** including tutorials.

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GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI
(An Autonomous Institute of Government of Maharashtra)
LIST OF MULTIDICIPLINARY MINOR COURSES:

Sr. No.	Offering Department	Name of Programme /Minor Course	Students from Department who can register
1	CSE	Data Science	CE,ME,EE,ENTC,INST
		Artificial Intelligence	CE,ME,EE,ENTC,INSTR
2	IT	Machine Learning	CE,ME,EE,ENTC,INST
		Software Engineering	CE,ME,EE,ENTC,INST
3	ENTC	IOT	CE,ME,EE,CSE,IT,INST
		Electronics and Telecommunication Engg.	CE,ME,EE,CSE,IT,INST
4	ME	Mechanical Engineering	CE,EE,ENTC,CSE,IT,INS
		Automation & Robotics	CE,EE,ENTC,CSE,IT,INS
		Industrial Management	ME,CE,ENTC,CSE,IT,EE,INST
5	CE	Building Construction and Management	ME,EE,ENTC,CSE,IT,INST
		Business Economics	ME,EE,ENTC,CSE,IT,INST,CE
6	EE	Energy Engineering	ME,CE,ENTC,CSE,IT,INST
		Electrical Motors & Drives	ME,CE,ENTC,CSE,IT,INST
7	INST	Instrumentation and Control	ME,CE,ENTC,CSE,IT,EE
		Banking and Finance	ME,CE,ENTC,CSE,IT,EE,INST

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Name of Programme /Minor Course	Course Code	Civil Engineering		Mechanical Engineering			Electrical Engineering	
		Building Technology (TRACK-I)	**Business Economics (TRACK-II)**	**Mechanical Engineering (TRACK-I)**	**Automation & Robotics (TRACK-II)**	**Industrial Management (TRACK-III)**	**Energy Engineering (TRACK-I)**	**Electrical Motors & Drives (TRACK-II)**
MinorCourse-1	XX1315/16/17	CE1315 Basics of Civil Engineering	CE1316 Principles of Macroeconomics	ME1315 Production Technology	ME1316 Hydraulics and Pneumatics	ME1317 Organizational Behaviour	EE1315 Introduction to Renewable Energy	EE 1316 Electrical Motors
MinorCourse-2	XX1415/16/17	CE1415 Building Construction	CE1416 Principles of Microeconomics	ME1415 New and Renewable Energy Sources	ME1416 Automation in Manufacturing	ME1417 Human Resource Management	EE1415 Energy Resources, Environment and Economics	EE 1416 Special Electrical Machines
MinorCourse-3	XX1515/16/17	CE1515 Building Planning & Drawing	CE1516 Business Statistics	ME1515 Automobile Engineering	ME1516 Mechatronic Systems	ME1517 Material Management	EE1515 Energy Efficiency in Electrical Utilities	EE 1516 Fundamentals of Power Electronics
MinorCourse-4	XX1615/16/17	CE1615 Building Estimates & Tendering	CE1616 Financial Accounting	ME1615 Basic of Product Design	ME1616 Industrial Robotics	ME1617 Marketing Management	EE1615 Energy Management	EE 1616 Electrical Drives and Control
MinorCourse-5	XX1715/16/17	CE1715 Construction Management	CE1716 Minor Project	ME1715 Industrial Management and Quality Control	ME1716 Computer Integrated Manufacturing	ME1717 Corporate Financial Reporting and Analysis	EE1715 Project	EE 1716 Project

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Name of Programme /Minor Course	Course Code	Electronics Engineering		Computer Engineering		Information Technology		Instrumentation Engineering	
		Internet of Things (TRACK-I)	Electronics and Telecommunication Engg. (TRACK-II)	Data Science (TRACK-I)	AI (TRACK-II)	Machine Learning (TRACK-I)	Software Engineering (TRACK-II)	Instrumentation and Control (TRACK-I)	Banking and Finance (TRACK-II)
MinorCourse-1	XX1315/16	ET1315 Introduction to internet of things	ET1316 Digital Circuits	CS1315 Fundamentals of data science	CS1316 Introduction to Artificial Intelligence	IT1315 Essential math for machine learning	IT1316 Data Structure & Algorithms	IN1315 Industrial Measurement I	IN1316 Bank operations Management
MinorCourse-2	XX1415/16	ET1415 IoT Architecture & Protocols	ET1416 Communication Engineering	CS1415 Computational Data Analytics	CS1416 Data Mining	IT1415 Artificial Intelligence	IT1416 Software Engineering	IN1415 Industrial Measurement II	IN1416 Strategic management and innovation in banking
MinorCourse-3	XX1515/16	ET1515 Programming with Arduino and Raspberry-Pi	ET1516 Microprocessor &Embedded System	CS1515 Natural Language Processing	CS1516 Introduction to Machine Learning	IT1515 Machine learning Foundation	IT1516 Object Oriented Design & Programming	IN1515 Control system Engineering	IN1516 Security analysis and portfolio management
MinorCourse-4	XX1615/16	ET1615 Industrial Internet of Things	ET1616 Wireless Communication	CS1615 Application of data science	CS1616 Optimization Methods in Machine Learning	IT1615 Fundaments: Deep Learning	IT1616 Software Testing	IN1615 Industrial Automation	IN1616 Spreadsheet based data analysis
MinorCourse-5	XX1715/16	ET1715 Project	ET1716 Project	CS1715 Marketing Analytics for Big Data	CS1716 Human Applications of AI	IT1715 Minor Project	IT1716 Minor Project	IN1715 Programming for PLAC,DCS & SCADA	IN1716 IT operations &Management

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LIST OF OPEN ELECTIVE COURSES			
	OPEN ELECTIVE-I	**OPEN ELECTIVE-II**	**OPEN ELECTIVE-III**
COURSE CODE	SH1401	SH1501	SH1701
A	**Appreciating Indian Music**	**Environmental law**	**Operational Research**
B	**Introduction to Human Psychology**	**Cyber law**	**Digital Marketing**
C	**Nanotechnology, Science and Application**	**Introduction to Mass Communication**	**Biology for Engineers**
D	**Introduction to Exercise Physiology & Sports Performance**	**Foreign Language Japanese (N5) /German (A1)**	**Foreign Language Japanese (N4) /German (A2)**
	SWAYAM/NPTEL https://onlinecourses.nptel.ac.in/noc22_hs57/preview https://onlinecourses.nptel.ac.in/noc24_hs39/preview https://onlinecourses.nptel.ac.in/noc19_mm21/preview https://onlinecourses.nptel.ac.in/noc24_hs86/preview	**SWAYAM/NPTEL**	**SWAYAM/NPTEL**

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LIST OF PROGRAM ELECTIVES HONOR'S COURSES (Swayam/NPTEL)	
COURSE CODE	**<Name of Area >**
EE1521	Digital Signal Processing (NPTEL, IIT Bombay,Prof. V. M. Gadre) https://onlinecourses.nptel.ac.in/noc24_ee16/preview
EE1522	Operation and Planning of Power Distribution Systems (NPTEL, IIT Guwahati, Sanjib Ganguly) https://nptel.ac.in/courses/117103149
EE1621	Transmission Lines and Electromagnetic Waves (NPTEL, IIT Madras, Ananth Krishnan) https://onlinecourses.nptel.ac.in/noc24_ee42/preview
EE1622	Industrial Automation and Controls (NPTEL, IIT Kharagpur, Alok Kanti Deb) https://onlinecourses.nptel.ac.in/noc24_ee56/preview
EE1721	Digital Control Systems (NPTEL, IIT Guwahati, Dr. Indrani Kar) https://nptel.ac.in/courses/108103008
EE1722	Power Quality (NPTEL, IIT Delhi, Bhim Singh) https://nptel.ac.in/courses/108102179

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LIST OF MINOR COURSES FOR DOUBLE MINOR (Electrical Engineering)	
COURSECODE	**Electrical Engineering**
EE1541	Network Analysis
EE1542	Electrical Machines
EE1641	Electrical Power
EE1642	Power Electronics
EE1741	Control Systems
EE1742	Electrical Drives and Control

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Sample Guidelines for the Honour with Research Project

The purpose of this course is to introduce students to the process of conducting research projects/work. The students will be helped to conceptualise, design and execute a research project by a teacher guide.

Stage-1:

- Student have to complete online course related to topic/perquisite course prescribed by the assigned guide/BOS
  OR
- The focus will be on discussions and analysis of assignments. Learners will be encouraged to read books and research journals related to his/her research topic (literature review, theory and hypotheses etc) and share them in the seminars and evaluated by two member Team of department and same to be enter in ICA format.

Stage-2:

Sample steps:

- Research design/Methodology
- Sampling tool of data collection
- data processing and analysis
- Plan of research report
- Publish review paper in peer view journal/Scopus indexed journal and seminar on it
- The faculty supervisor will assess the method and procedures used by the learner
- At end evaluated by two member Team of department

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Stage-3:

- If applicable initiate Actual implementation
- Data Analysis and Interpretation: The outcome of the research is presented in tabular form with the help of statistical procedures. The data are analysed and interpreted and presented in the form of a research report and presenatation/seminar.
- Report writing
- Publish paper on findings in peer view journal/Scopus indexed journal.
- Two member Team of department will assess the Findings method and procedures
- The faculty supervisor will assess the presentation of major findings depending on the methodology used, presentation of results, interpretation of the results with discussion, summary of the proposed research problem and conclusion.
- Two member Team of department (may evaluated by Guide and external expert) will assess the Findings method and procedures etc

Note : Guide Teaching load : 4 Hrs per student in Research stage -1/2/3

Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (OLD to NEW)

III Semester

S. N.	Course code with Name of course (OLD) Revised Curriculum 2019-20			Course code with Name of course(NEW) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	SHU321C SHU322C	Transform and Statistical methods Integral Calculus and Probability	4 4	--	--	--
2	EEU321	Transformers and DC Machines	3	EE1401	Electrical Machines - I	3
3	EEU322	Electrical Circuit Analysis	4	EE1302	Electrical Circuit Analysis	3
4	EEU323	Energy Resources and Generation	3	EE1223	Energy Resources and Generation	3
5	EEU326	Analog Electronic Circuits	3	--	--	--
6	SHU323	Introduction to Constitution of India	0	--	--	--
7	EEU327	Analog Electronic Circuits Lab	1	--	--	--
8	EEU324	Electrical Machines – Lab I	1	EE1404	Electrical Machines - I Laboratory	1
9	EEU325	Electrical Circuit Analysis Lab	1	EE1304	Electrical Circuit Analysis Laboratory	1

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (NEW to OLD)

III Semester

S. N.	Course code with Name of course (NEW) Revised Curriculum 2019-20			Course code with Name of course (OLD) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	SH1301C	Transform and Differential Equations	3	--	--	--
2	EE1315/ EE1316	Multidisciplinary Minor 1	3	--	--	--
3	EE1301	Electromagnetic Fields	4	EEU423	Electromagnetic Fields	4
4	EE1302	Electrical Circuit Analysis	3	EEU322	Electrical Circuit Analysis	4
5	EE1303	Signals & Systems	3	EEU422	Signals & Systems	3
6	EE1304	Electrical Circuit Analysis Laboratory	1	EEU325	Electrical Circuit Analysis Lab	1
7	EE1305	Electrical Measurements and Measuring Instruments Laboratory	2	EEU424	Electrical Measurement and Instrumentation Lab	3
8	EE1310	Idea Laboratory	1	--	--	--

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (OLD to NEW)

IV Semester

S. N.	Course code with Name of course (OLD) Revised Curriculum 2019-20			Course code with Name of course (NEW) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	EEU421	AC Machines	3	EE1502	Electrical Machines – II	3
2	EEU422	Signals & Systems	4	EE1303	Signals & Systems	3
3	EEU423	Electromagnetic Fields	4	EE1301	Electromagnetic Fields	4
4	EEU426	Digital Electronics	3	--	--	--
5	SHU425	Human Values and Ethics	0	--	--	--
6	EEU424	Electrical Measurement and Instrumentation Lab	3	EE1305	Electrical Measurements and Measuring Instruments Laboratory	2
7	EEU427	Digital Electronics Lab	1	--	--	--
8	EEU425	Electrical Machines Lab II	1	EE1507	Electrical Machines – II Laboratory	1
9	SHU422	Environmental Studies	0	--	--	--

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (NEW to OLD)

IV Semester

S. N.	Course code with Name of course (NEW) Revised Curriculum 2019-20			Course code with Name of course (OLD) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	EE1415/ EE1416	Multidisciplinary Minor 2	3	--	--	--
2	EE1401	Electrical Machines - I	3	EEU321	Transformers and DC Machines	3
3	EE1402	Microprocessors and Microcontrollers	3	EEU524	Microprocessor and Microcontrollers	3
4	EE1403	Power Electronics	3	EEU521	Power Electronics	3
5	SH1401	Open Elective 1	3	--	--	--
6	EE1404	Electrical Machines - I Laboratory	1	EEU324	Electrical Machines – Lab I	1
7	EE1405	Microprocessors and Microcontrollers Laboratory	1	EEU530	Microprocessor and Microcontrollers Lab	1
8	EE1406	Power Electronics Laboratory	1	EEU527	Power Electronics Lab	1
9	SH1402	Co-curricular Course	2	--	--	--

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (OLD to NEW)

V Semester

S. N.	Course code with Name of course (OLD) Revised Curriculum 2019-20			Course code with Name of course (NEW) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	EEU521	Power Electronics	3	EE1403	Power Electronics	3
2	EEU522	Power Systems – Apparatus and Modelling	4	EE1501	Electrical Power – I	3
3	EEU523	Control System	3	EE1503	Control System	3
4	EEU524	Microprocessor and Microcontrollers	3	EE1402	Microprocessors and Microcontrollers	3
5	EEU525	Industrial Organization & Management	3	--	--	--
6		**Program Elective – I**				
	EEU526-A	Electrical Machine Design	3	EE1504A	Electrical Machine Design	4
	EEU526-B	Industrial Electrical Systems	3	--	--	--
	EEU526-C	Digital Signal Processing	3	--	--	--
	EEU526-D	Computer Organization	3	--	--	--
	EEU526-E	Embedded Systems	3	--	--	--
7	EEU527	Power Electronics Lab	1	EE1406	Power Electronics Laboratory	1
8	EEU528	Power Systems – Apparatus and Modelling Lab	1	EE1506	Electrical Power – I Laboratory	1
9	EEU529	Control Systems Lab	1	EE1508	Control System Laboratory	1
10	EEU530	Microprocessor and Microcontrollers Lab	1	EE1405	Microprocessors and Microcontrollers Laboratory	1

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (NEW to OLD)

V Semester

S. N.	Course code with Name of course (NEW) Revised Curriculum 2019-20			Course code with Name of course (OLD) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	EE1515/ EE1516	Multidisciplinary Minor 3	3	--	--	--
2	EE1501	Electrical Power – I	3	EEU522	Power Systems – Apparatus and Modelling	4
3	EE1502	Electrical Machines – II	3	EEU421	AC Machines	3
4	EE1503	Control System	3	EEU523	Control System	3
5		**Program Elective 1**				
	EE1504-A	Electrical Machine Design	4	EEU526-A	Electrical Machine Design	3
	EE1504-B	Energy Efficiency in Electrical Utilities	4	--	--	--
	EE1504-C	Electric and Hybrid Electric Vehicles	4	--	--	--
6	SH1501	Open Elective 2	3	--	--	--
7	EE1505	Professional Software Lab	1	--	--	--
8	EE1506	Electrical Power – I Laboratory	1	EEU528	Power Systems – Apparatus and Modelling Lab	1
9	EE1507	Electrical Machines – II Laboratory	1	EEU425	Electrical Machines Lab II	1
10	EE1508	Control System Laboratory	1	EEU529	Control Systems Lab	1
11	SH1502	Co-curricular Course	2	--	--	--
12	SH1503	Soft Skills	0	--	--	--

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (OLD to NEW)

VI Semester

S. N.	Course code with Name of course (OLD) Revised Curriculum 2019-20			Course code with Name of course (NEW) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	EU621	Power Systems –Operation and Control	3	EE1601	Electrical Power – II	3
2	EEU622	Control System Design	4	EE1602	Control System Design	3
3	EEU623	Operation Research Techniques	4	--	--	--
4		**Program Elective – II**			**Program Elective 2**	
	EEU624-A	Power System Protection	3	EE1603-A	Power System Protection	4
	EEU624-B	Energy Conservation in Electrical Utilities	3	--	--	--
	EEU624-D	Object Oriented Programming	3	--	--	--
	EEU624-E	Internet of Things	3	--	--	--
5	EEU633	**Open Elective – I**				
	EEU633-A	Electromechanical Energy Conversion	3	--	--	--
	EEU633-B	Energy Efficiency in Electrical Utilities	3	--	--	--
6	ETU631	Electronics Design Lab	3	--	--	--
7	EEU626	Power Systems –Operation and Control Lab	1	EE1605	Electrical Power – II Laboratory	1
8	EEU627	Control System Design Lab	1	--	--	--
9	EEU628	Minor Project	1	EE1606	Minor Project	2

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Equivalence Scheme

Programme Name:- B. Tech. Electrical Engineering (NEW to OLD)

VI Semester

S. N.	Course code with Name of course (NEW) Revised Curriculum 2019-20			Course code with Name of course (OLD) (NEP Version-II)		
	Code	Course Name	Credits	Code	Course Name	Credits
1	EE1615/ EE1616	Multidisciplinary Minor 4	3	--	--	--
2	EE1601	Electrical Power – II	3	EEU621	Power Systems – Operation and Control	3
3	EE1602	Control System Design	3	EEU622	Control System Design	4
4		**Program Elective 2**			**Program Elective – II**	
	EE1603-A	Power System Protection	4	EEU624-A	Power System Protection	3
	EE1603-B	Energy Resources, Environment and Economics	4	--	--	--
	EE1603-C	EV Battery and Chargers	4	--	--	--
5		**Program Elective 3**			**Program Elective – III**	--
	EE1604-A	EHV AC Transmission	4	EEU722-A	EHV AC Transmission	
	EE1604-B	Introduction to Renewable Energy	4	--	--	--
	EE1604-C	EV Motors and Power Converters	4	--	--	--
6	EE1605	Electrical Power – II Laboratory	1	EEU626	Power Systems –Operation and Control Lab	1
7	EE1606	Minor Project	2	EEU628	Minor Project	1
8	EE1607	Electrical Estimation and Costing	0	--	--	--
9	SH1601	NCC/NSS	0	--	--	--

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SEMESTER – III

Course Code	SH1301(C)	Course category	BS
Course Name	TRANSFORM AND DIFFERENTIAL EQUATIONS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs. 30 min.	--	--	100	03

Course Objectives:

1. To study solution of partial differential equations and apply it to solve wave and heat equations.
2. To learn Laplace transform and its properties. Apply it to solve differential equation
3. To equip students with Vector spaces mostly used in varied applications in engineering and science.
4. To learn inner product spaces and related processes.
5. To learn vector calculus and their applications

Course Contents:

Partial differential equations and its applications:

Definition, formation of partial differential equation, Lagrange's linear equation, nonlinear equations of the first order. method of separation of variables for solving second order Partial differential equations, Solutions of wave equation, one dimensional heat flow equation and two-dimensional heat flow equation in steady state (Laplace equation)

Laplace Transform:

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic Functions, Inverse Laplace Transform, Convolution theorem. Unit step function, unit impulse function. Applications of Laplace transforms to linear differential equations and simultaneous linear differential equations

Vector Spaces:

Vector spaces and Subspaces, Linear dependence and Independence of vectors, Bases and dimensions, Coordinate vectors, Linear transformation, Algebra of linear transformation, Representation of linear transformation of matrices relative to basis.

Random Variables and Probability Distributions:

Random variables, Discrete and Continuous random variables, Distribution functions, Probability distribution of continuous random variable. Joint distribution of discrete and continuous random variables, Conditional distribution, Mathematical expectation, Mean, moments and variance. Variance for joint distribution and Covariance

Vector Calculus:

Scalar and vector fields, line and surface integrals, gradient, divergence and curl, directional derivative, line integral independent of path, Green's, Gauss divergence and Stoke's theorems (Without proofs) and their simple applications

Text books:

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers,2020, 44th edition.
2. Advanced Engineering Mathematics, H. K. Das, S. Chand & Company Pvt.Ltd,2014.
3. A text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Volume-I and Volume-II Laxmi Publications, Reprint,2023

Reference books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Higher Engineering Mathematics, B.V. Ramana, Tata McGraw Hill Publishing company Ltd. New Delhi,2008, 6th edition.
3. Advanced Engineering mathematics, Reena Garg, Khanna book publishing company, 2021
4. Introduction to Probability Theory, P. G. Hoel, S. C. Port and C. J. Stone, Universal Book Stall, 2003(Reprint).
5. A First Course in Probability, S. Ross, 6th Ed., Pearson Education India,2002.
6. An Introduction to Probability Theory and its Applications, W. Feller, Vol. 1, 3rd Ed., Wiley, 1968

Course Outcomes:

After the successfully completion of the course the student will able to

SH1301C.1 Study solution of partial differential equations and apply it to solve wave and heat equations.

SH1301C.2 Study Laplace transform and its properties. Apply it to solve differential equation

SH1301C.3 Equip students with Vector spaces mostly used in varied applications in engineering and science.

SH1301C.4 Study inner product spaces and related processes.

SH1301C.5 Solve vector calculus problems and their applications

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
SH1301C.1	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-
SH1301C.2	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-
SH1301C.3	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-
SH1301C.4	3	3	3	3	3	-		-	-	-	-	-	2	-	-
SH1301C.5	3	3	3	3	3	-	-	-	-	-	-	-	2	-	-

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	EE1301	Course Category	PC
Course Name	ELECTROMAGNETIC FIELDS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2 hrs 30 min	--	--	100	04

Course Objectives:

To make the students aware and understand:

1. The Vector calculus.
2. The static electric fields and magnetic fields.
3. The time varying fields.

Course Contents:

Module-I: Review of Vector Calculus

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module-II: Static Electric Field

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module-III: Conductors, Dielectrics and Capacitance

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module-IV: Static Magnetic Fields

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module-V: Magnetic Forces, Materials and Inductance

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

Module-VI: Time Varying Fields and Maxwell's Equations

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Reference Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

Course Outcomes:

On completion of the course, students will be able to:

EE1301.1 To apply the vector calculus on the static electric fields.
EE1301.2 To understand conductors, dielectrics and capacitance.
EE1301.3 To apply the vector calculus on the static magnetic fields.
EE1301.4 To understand magnetic forces, materials and inductance.
EE1301.5 To evaluate time varying fields and Maxwell's equations.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE13021.1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
EE1301.2	2	1	-	2	-	-	-	-	-	-	-	-	2	-	-
EE1301.3	3	1	1	1	-	-	-	-	-	-	-	-	2	-	-
EE1301.4	2	2	-	1	-	-	-	-	-	-	-	-	2	-	-
EE1301.5	3	2	1	-	-	-	1	-	-	-	-	-	2	-	-

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Course Code	EE1302	Course category	PC
Course Name	ELECTRICAL CIRCUIT ANALYSIS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs. 30 min.	--	--	100	03

Course Objectives:

Students will be able to:

1. Analyze electrical network problems.
2. Determine transient and steady state behavior of the electrical networks
3. Estimate the parameters of two port networks.

Course Contents:

Network Theorems

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel R-L, R-C, R- LC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Sinusoidal steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Textbooks/ References:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.
6. Sudhakar Shyammohan, "Circuit and Network Analysis", Tata McGraw Hill 2005

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

EE1302.1 Apply network theorems for the analysis of electrical circuits.
EE1302.2 Obtain the transient and steady-state response of electrical circuits.
EE1302.3 Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
EE1302.4 Analyze circuits using Laplace transform.
EE1302.5 Analyze two port circuit behavior.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1302.1	2	-	-	-	1	1	1	-	-	-	-	-	1	-	-
EE1302.2	2	-	-	-	1	1	1	-	-	-	-	-	1	-	-
EE1302.3	2	-	-	-	1	1	1	-	-	-	-	-	1	-	-
EE1302.4	2	-	-	-	1	1	1	-	-	-	-	-	1	-	-
EE1302.5	2	-	-	-	-	1	2	-	-	-	-	-	1	-	-

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Course Code	EE1303	Course Category	PC
Course Name	SIGNALS & SYSTEMS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs 30 min	--	--	100	03

Course Objectives:

After the completion of the course, the students will be able to:

1. Understand about various types of signals, classify them, analyse them and perform various operations on them.
2. Understand about various types of systems, classify them, analyse them and understand their response behaviour.
3. Appreciate use of Fourier transform in analysis of signals and systems.
4. Apply Z- transform in analysis of signals and systems.
5. Learn the sampling and reconstruction of signals.

Course Contents:

Introduction to Signals and Systems:

Signals and systems - everyday life, biomedical, instrumentation domestic and industries. Representations of Signals, Classifications of Signals – Continuous time, Discrete time, comparison among Analog, Digital and Discrete Signals, Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, and the complex exponential. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples**.**

Behaviour of Continuous time (CT) & Discrete Time (DT) Linear Time Invariant (LTI) System:

Addition, subtraction, multiplication and division of the signals, parallel and series combinations of the systems, cascading of the systems, impulse response characterization and convolution integral for CT- LTI system, signal responses to CTLTI system, properties of convolution, LTI system response properties from impulse response, Examples. Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system, DT-LTI system properties from Impulse response. System analysis from difference equation model, examples.

Introduction to Fourier Series, Fourier Transform:

Fourier Series Representation of periodic Signals, Fourier series, Waveform Symmetries, Calculation of Fourier Coefficients, Frequency spectrum of aperiodic signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform. Parseval's theorem, Properties of Continuous Time Fourier transform. System Analysis using Fourier Transform. Introduction to DTFT and DFT.

Laplace and Z Transforms:

Review of the Laplace transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The Z-Transform, Convergence of Z-Transform, Properties of Z-Transform, Inverse Z-Transform, LTI System analysis from Linear Constant Coefficient Difference Equations using Z-Transform

Sampling and the Reconstruction:

Representation of the digital signals, The Sampling Theorem, Sampling with a zero order hold, first order hold, Reconstruction of the signal from its samples using interpolation, aliasing and its effects, Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text Books:

1. Alan V. Oppenheim, Alan S. Wilsky and Nawab, Signals and Systems, Prentice Hall India, 1997
2. B. P. Lathi, Linear Systems and signals, Oxford University press, 2009.
3. P. Ramesh Babu, R. Anandanatarajan, Signals and Systems, fourth Edition, Scitech Publications (INDIA), Pvt. Ltd.

Reference Books:

1. Signals and Systems by Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications
2. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications
3. Signal and Systems by Anand Kumar, 3rd Edition, PHI
4. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Pearson. 2006.
5. Ashok Ambardar, Analog and Digital Signal Processing, Second Edition, Brooks/Cole Publishing Company

Course Outcomes:

On completion of the course, students will be able to:

EE1303.1 Understand the concepts of Continuous –time and Discrete-time signals.
EE1303.2 Understand the concepts of Continuous –time and Discrete-time systems.
EE1303.3 Examine the response of the systems for various signals.
EE1303.4 Analyse the systems in complex frequency domain.
EE1303.5 Apply sampling theorem and observe its implications.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1303.1	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1303.2	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1303.3	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1303.4	2	-	-	-	-	1	2	-	-	-	-	-	1	-	-
EE1303.5	2	-	-	-	1	1	2	-	-	-	-	-	2	-	-

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Course Code	EE1304	Course category	VSE
Course Name	ELECTRICAL CIRCUIT ANALYSIS LABORATORY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make the students aware and understand:

1. Various electrical circuit theorems.
2. Two port network parameters.
3. Steady state response of electrical circuits

Minimum Eight Hands-on experiments related to the course contents of EE1302 Electrical Circuit Analysis to be performed. Representative list is as follows:

1. To find self-inductance of two coils, mutual inductance between the coils and coefficient of coupling.
2. To verify Maximum Power Transfer theorem.
3. To verify Compensation theorem.
4. To verify Tellegen's theorem.
5. To find Z parameters of two, two port networks connected in series.
6. To find Y parameters of two, two port networks connected in parallel.
7. To determine ABCD parameters of given two port network.
8. To find transmission parameters of two, two port networks connected in cascade.
9. To study the response of RL series circuit to sinusoidal input and dc input (using MATLAB).
10. To study the response of RC series circuit to sinusoidal input and dc input (using MATLAB).

Course Outcomes:

After completion of the course, the students will be able to:

EE1304.1 Construct simple electrical circuits using suitable elements
EE1304.2 Perform experiments for verification of various facts and principles
EE1304.3 Derive conclusions on the basis of the readings /observations

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1304.1	3	1	1	--	3	--	--	--	--	--	--	--	3	3	--
EE1304.2	3	2	1	1	3	--	--	--	--	--	--	--	3	3	--
EE1304.3	3	2	1	1	3	--	--	--	--	--	--	--	--	--	--

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Course Code	EE1305							Course category			VSE
Course Name	ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS LABORATORY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT 1	CT 2	TA	ESE	ESE Duration	ICA	ESE		
01	--	02	03	--	--	--	--	--	25	25	50	02

Course Objectives:

To make the students aware and understand:

1. Necessity and importance of Measurement & Instrumentation.
2. Different bridge circuits used for measurement of electrical parameters such as R, L, C.
3. Operation of signal generators and analyzers, analog and digital instruments and recorders.

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution,
2. Drift, Hysteresis, Dead-band, Sensitivity. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers, Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope

Experiments:

Minimum Eight Hands-on experiments to be performed. Representative list is as follows.

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.

4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of capacitance by De-Sauty's method.
6. Measurement of inductance by Maxwell inductance Capacitance Bridge.
7. Measurement of High resistance and Insulation resistance using Megger.
8. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale.
9. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
10. Usage of DSO to capture transients like a step change in R-L-C circuit.
11. Current Measurement using Shunt, CT, and Hall Sensor.
12. Study of Digital / Smart / TOD energy meters.

Course Outcomes:

On completion of this course, the students will able to:

EE1305.1 Appreciate various aspects of the art and science of measurement and instrumentation.
EE1305.2 Know about different measurement methods, sensors and transducers.
EE1305.3 Identify and evaluate AC and DC bridges for measurement of R, L and C
EE1305.4 Analyze the dynamic response and the calibration of few instruments. EEU
EE1305.5 Understand statistical data analysis and computerized data acquisition.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1305.1	2	-	-	-	-	2	2	2	--	1	1	1	2	1	2
EE1305.2	2	3	-	-	-	1	2	1	--	1	1	1	2	1	2
EE1305.3	3	2	1	1	-	1	2	1	--	1	1	1	2	1	2
EE1305.4	2	3	-	1	-	1	1	1	-	1	1	1	2	2	2
EE1305.5	3	2	1	-	-	1	3	3	-	1	1	1	1	1	3

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Course Code	EE1310							Course category			EM1
Course Name	IDEA LABORATORY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
-	-	02	02	-	-	-	-	-	50	-	50	01

Course Objectives:

1. Understand design thinking and innovation concepts and approaches.
2. Understand the problems faced by society.
3. Identify new and unaddressed social needs.
4. Design and development of Small project based on Laboratory equipment like Machine hardware, Electronic hardware and software etc.

Students are expected to complete work in group of max.three students in pertaining to following aspects under the supervision of course coordinator/teacher.

1. Demonstration of modern manufacturing facilities available at the institute
2. Demonstration of automation and programming tools.
3. Active Sessions on brainstorming, creativity, idea generation, problem-solving techniques and new product development.
4. Visit social sites for the identification of social needs and community problems. The report on this visit is to be submitted.
5. Identification of product problems through customer surveys.
6. The minor project based on hardware (along with software if desire).
7. Building prototype and identifying modifications.
8. Write a project report.
9. The Course Coordinator/Teacher may arrange demonstration with poster presentation of all minor projects developed by the students at the end of semester.

Course Outcomes:

EE1310.1 Gain knowledge of design thinking and innovation with the modern machines and devices available in the idea lab.

EE1310.2 Generate different ideas for innovative products through ideation and brainstorming.

EE1310.3 Identify, discuss and justify the technical aspects of the chosen idea with a comprehensive and systematic approach.

EE1310.4 Design and develop innovative products for specific problems considering user- centric perspective and market.
EE1310.5 Communicate and report effectively project related activities.

References Books:

1. Ulrich, Karl T., Steven D. Eppinger, and Maria C. Yang. Product design and development Vol. 4. Boston: McGraw-Hill higher education, 2008.
2. Mueller-Roterberg, Christian. "Handbook of design thinking." Independently publish 2018 (2018).
3. Koh, Joyce Hwee Ling, et al. Design thinking and education. Springer Singapore, 2015.
4. Uebernickel, Falk, et al. Design thinking: The handbook. World Scientific, 2020.
5. Woolery, Eli. Design thinking handbook. In Vision, 2019.

Web Resource:

1. https://www.coursera.org/learn/uva-darden-design-thinking-innovation?action=enroll
2. https://www.mygreatlearning.com/academy/learn-for-free/courses/design-thinking

Note:-

- ICA – The Internal Continues Assessment shall be based on project development and knowledge/skill acquired. The performance shall be assessed experiment wise using continues assessment format A and B.

CO-PO-PSO Mapping

CO	PO / PSO														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1310.1															
EE1310.2															
EE1310.3															
EE1310.4															
EE1310.5															

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SEMESTER – IV

Course Code	EE1401								Course category			PC
Course Name	ELECTRICAL MACHINES -I											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Basic concept of Electromagnetic force and torque in rotating machines
2. Construction, Operation and testing of dc machines
3. Operation and testing of transformers (single-phase and three-phase)

Course Contents:

DC Machines

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.

DC Machine - Motoring and Generation

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.

Transformers

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.

Text Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

References Books:

1. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

EE1401.1 Know the concepts of Electromagnetic force and torque.
EE1401.2 Understand the operation of dc machines.
EE1401.3 Evaluate the differences in operation of different dc machine configurations.
EE1401.4 Investigate the performance of dc machines and transformer by testing
EE1401.5 Analyse single phase and three phase transformers circuits and connections

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1401.1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
EE1401.2	2	3	1	2	--	-	-	-	-	-	-	-	3	-	-
EE1401.3	3	2	1	2	--	-	-	-	-	-	-	-	2	-	-
EE1401.4	3	2	1	-	-	-	1	-	-	-	-	-	3	-	-
EE1401.5	2	1	1	-	-	-	-	-	-	-	-	-	2	-	-

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Course Code	EE1402	Course category	PC
Course Name	MICROPROCESSORS AND MICROCONTROLLERS		

Teaching Scheme				Examination Scheme								
Th	Tu	Pr	Total	Theory					Practical		Total	Credits
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

Students will be able to:

1. Explain the basic fundamentals and hardware of the microprocessor and microcontrollers.
2. Impart the knowledge of the programming/software used to develop programs.
3. Interface a variety of external devices with microcontrollers.

Course Contents:

Fundamentals of Microprocessors: Fundamentals of Microprocessor Architecture. 8-bit Microprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

The 8051 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Memory and I/O Interfacing: Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, and memory devices.

External Communication Interface and applications: Synchronous and Asynchronous Communication. RS232, SPI, I2C. LED, LCD and keyboard interfacing.

Text Books/ Reference Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3. R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996.
4. R. Kamal, "Embedded System", McGraw Hill Education, 2009.
5. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.
6. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

Web Resources:

1. NPTEL Web course on Microprocessor by Dr.PramodAgarwal, IIT Roorkee. https://nptel.ac.in/courses/108/107/108107029/
2. NPTEL Web course on Microcontrollers and Applications by Dr. S. P. Das, IIT Kanpur. https://nptel.ac.in/courses/117/104/117104072/

Course Outcomes:

On completion of the course, students will be able to:

EE1402.1 Explore the basics of microprocessor and microcontroller.

EE1402.2 Understand the internal design of 8051 microcontroller along with its features and programming.

EE1402.3 Demonstrate the limitations and strengths of microprocessor and microcontrollers, and their comparison.

EE1402.4 Apply the knowledge to design different interfacing applications using microcontrollers and peripherals.

EE1402.5 Explore the use of microcontroller in real time applications.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1402.1	2	1	-	-	-	-	-	-	-	-	-	-	1	2	1
EE1402.2	2	1	2	2	1	-	-	-	-	-	-	-	1	2	1
EE1402.3	1	1	1	2	2	-	-	-	-	-	-	1	1	1	1
EE1402.4	1	1	-	-	-	-	-	-	-	-	-	-	1	-	1
EE1402.5	1	-	-	2	2	-	-	-	-	-	-	1	2	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Member Secretary

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Dean, Academics

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Principal

Course Code	EE1403	Course Category	PC
Course Name	POWER ELECTRONICS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

The students will be able to:

1. Understand the role of Power Electronics in society.
2. Select and use various power electronics devices.
3. Analyze AC/DC, DC/DC, DC/AC converters.

Course Contents:

Introduction to Power Electronics and Power Devices:

Applications, definitions and nature of power electronic circuits. Components of a power electronic system.
Ideal switch, diode static characteristics, diode dynamic characteristics, introduction to diac and triac. SCR - operation, static and dynamic characteristic. Bipolar junction transistor - operation, static and dynamic characteristics.
MOSFETs and IGBTs - operation, static and dynamic characteristics, parallel operation and loss calculation. Introduction to SiC and GaN devices.

Gate and Base Drive Circuits and Protection of Devices:

Gate Driver Circuits: Preliminary design considerations, dc-Coupled drive circuits, electrically isolated drive circuits, Cascade-connected drive circuits, thyristor drive circuits, power device protection in drive circuits, circuit layout considerations.

Snubber Circuits: Non-polarised RC snubber, Polarised switching-aid circuits: The polarized turn-off snubber circuit - assuming a linear current fall, The turn-off snubber circuit - assuming a sinusoidal current fall, The polarized turn-on snubber circuit - with air core (non-saturable) inductance, The polarized turn-on snubber circuit - with saturable ferrite inductance, The unified turn-on and turn-off snubber circuit. Snubbers for bridge legs.

Line-frequency diode rectifiers and phase-controlled rectifiers:

Diode bridge rectifiers: Single phase Half wave with R load, R-L load. Single phase Full bridge rectifier with dc link capacitive filter, issue of harmonics. Three phase Full bridge rectifier with dc link capacitive filter, issue of harmonics.

Phase-controlled rectifiers: Single phase fully-controlled AC to DC converter: Principle of operation, issue of line commutation, continuous mode of conduction: expression for average output voltage, discontinuous mode of conduction (Operation only), analysis with R-L-E load, significance of R-L-E load, operation as an inverter: constraints for line commutation. Dual converter: motivation, input displacement factor, distortion factor, harmonics, effect of source inductance.
Three phase fully controlled AC to DC converter: Principle of operation, derivation of average output voltage, derivation of displacement factor, inverter mode of operation, constraints of commutation in inverter mode, effect of source inductance.
Single phase half-controlled converter: Operating principle, input displacement factor, modes of operation in the voltage-current plane.
Three phase half wave AC to DC converter: Principle of operation, derivation of output voltage, issue of dc magnetization of the input transformer.

DC- DC Power Converters:

Limitations of Linear Power supplies, switched power supplies (Buck, Buck-Boost, Boost, Cuk, Fly-back and Forward Converters) (Operation only).

DC- AC Power Converters:

Principle of operation of Inverters: Half bridge, full bridge, three phase- six step operation (Operation only). Introduction to PWM techniques: Single, Multiple and Sinusoidal PWM.

Text Books:

1. Power Electronics-Circuits Devices and Application, M. H. Rashid 2nd Ed., Prentice Hall of India (PHI) Pvt. Ltd., New Delhi, 2003.
2. Power Electronics – Converters, Applications and Design, Mohan, Undemand, Robbins, 3rd Ed., John Willey & Sons, 2004

Reference Books:

1. Cyril W. Lander, "Power electronics", 3rd Ed., McGRAW-HILL Publishing Company, 1993.
2. Power Electronics–Devices, Drivers and Applications, B. W. Williams, John Wiley, 2005
3. Power Electronics Principles and Applications, Joseph Vithyathil, Tata MC-Graw-Hill Edition, 2010

Web Resources:

1. http://www.nptel.iitm.ac.in
2. www.ocw.mit.edu

Course Outcomes:

On completion of the course, students will be able to:

EE1403.1	Understand the role of Power Electronics in control and conversion of Electrical power along with various semiconductor device characteristics.
EE1403.2	Develop designing skills for device fabrication and protection.
EE1403.3	Analyse diode and phase-controlled rectifiers.
EE1403.4	Compare various DC-DC power converters and understand their working.
EE1403.5	Apply various PWM techniques to DC-AC power converters and understand inverters working.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1403.1	2	0	1	0	0	1	1	0	0	0	0	1	2	1	1
EE1403.2	3	2	3	3	2	0	0	0	0	0	0	0	3	0	0
EE1403.3	2	3	2	2	0	0	0	0	0	0	0	0	3	0	0
EE1403.4	3	2	1	1	0	0	1	0	0	0	0	0	2	0	0
EE1403.5	3	2	1	1	0	0	0	0	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH1401A	Course Category	OE1
Course Name	Appreciating Indian Music		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	30	2 hrs 30 min	-	-	100	03

Course Objectives:

1. To familiarize students with the historical and cultural context of Indian Classical Music.
2. To introduce students to the fundamental concepts of raga, tala, and improvisation.
3. To develop students' listening skills through analysis and appreciation of classical music recordings.
4. To provide students with practical training in basic vocal or instrumental techniques.
5. To encourage critical thinking and reflection on the aesthetic and philosophical aspects of Indian Classical Music.

Course Contents:

Introduction to Indian Music:
Historical overview: origins, evolution, and major developments, definitions (sangeet, swar and its types, saptak and its types, aroha, aavaroha, pakad, alankar, wadi swar, sanvadi swar,varjit swar, sthayi and antara) Regional variations and prominent classical music traditions (Hindustani and Carnatic). Influence of spirituality, mythology, and philosophy on Indian Classical Music.

Fundamentals of Raga:
Understanding the concept of raga (melodic framework) and its elements, Notation systems and the role of improvisation within the framework of raga (Paluskar and Bhatkhande lipi), Different THAATs and their brief information, Definition of Raga, Sargam geet, the concept of Khyal , aalap and tana, Raga and Time Association, Basic ragas (Bhupali, Yaman, Bhimpalasi and Kedar) along with Aaroha, avaroha, pakad and sargam geet and khyal.

Introduction to Taala:
Understanding the components of a tala cycle (Defining- Taal, Lay and its types, matras, theaka, sum,tali, kaal, avartan).
Study of common talas (Teental, Rupak, Kehrarva, Dadra and Bhajni Theaka)
Practical exercises in clapping and counting rhythms to internalize talas.

Introduction to Musical Instruments:
Classification of Indian Musical Instruments (String, wind, percussion and Solid Instruments), components parts of Indian classical instruments along with neat sketch
Biography- Ustad Zakir Husen (Tabla), Pandit Appa Jalgaokar (Harmonium)
Pandit Ravi Shankar (Sitar), Pandit Hari Prasad Chaurasiya (Flute), Dr. N Rajam (Violin)

Textbooks:
1. Indian Classical Music By Ravi S. Prasanna
2. Appreciating Indian Music By Emmons E. White
3. Fundamental of Indian Music By. S. Sharma.

References:
1. Indian Music By Dr. Thakur J. Sing
2. Finding the Raga By Amit Choudhari.
3.History of Indian Music By B. A. Pingle
4. Raga Harmony By L. Subramaniam

Course Outcomes:
After successful completion of this course student will be able to

SH1401A.1: Students will demonstrate an understanding of the historical development and cultural significance of various genres and styles of Indian music.
SH1401A.2: Students will understanding classical, folk, and contemporary forms, by discussing key historical milestones and movements.
SH1401A.3: Students will be able to applying knowledge of musical elements such as raga, tala, swara, and laya to identify stylistic features, structural patterns, and aesthetic qualities.
SH1401A.4: Students will develop skills and competencies relevant to careers in music education. SH1401A.5: Students will develop skills and competencies relevant to research, arts administration, cultural advocacy, or related fields, preparing them for further academic pursuits or professional endeavors in the music industry.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1401A.1	1	0	0	0	0	1	2	2	3	0	0	0
SH1401A.2	1	0	0	0	0	1	2	2	3	0	0	0
SH1401A.3	1	0	0	0	0	1	2	2	3	0	0	0
SH1401A.4	1	0	0	0	0	1	2	2	3	0	0	0
SH1401A.5	1	0	0	0	0	1	2	2	3	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Sign
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Course Code	SH1401B								Course Category			OE1
Course Name	Introduction to Human Psychology											
Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs 30 min	-	-	100	03

Course Objectives:

To make the students will be able to:

1. Understand the human behaviour.
2. Helps humans in exerting more control over situations
3. Basic cognitive processes that guide human behaviours.
4. Tackling everyday problems and attaining optimal solutions
5. Knowledge about human cognitive systems in designing sophisticated Artificial Intelligence (AI) systems.

Course Contain:

Introduction to Cognitive Psychology:

- History,
- Theory
- Research in Human Cognition

Basic Cognitive Processes:

- Object Perception and Recognition
- Attentional Processes and cognition
- Memory Introduction
- Long Term Memory

Organizational Knowledge:

- Memory of general knowledge.
- Concept Formation
- Visual and Spatial Memory

The Use of Knowledge:

- Human language skills.
- Thought process and Problem Solving
- Reasoning
- Decision Making

Textbooks:

1. Kathleen Galotti, Cognitive Psychology, Cengage Learning.
2. Robert Stenberg, Applied Cognitive Psychology, Cengage Learning.

References:

1. Bridger Riegler, Cognitive Psychology, Pearson Press
2. Stephen Kosslyn, Cognitive Psychology, PHI Press

Course Outcomes:

At the end of this course, students will demonstrate the ability to
SH1401B.1: To learn history of Human Psychology.
SH1401B.2: To understand, theory and research in Human Psychology.
SH1401B.3: To learn the Basic Cognitive Processes.
SH1401B.4: To understand about Organizational Knowledge.
SH1401B. 5: Apply the knowledge of human Psychology to developed process of problem solving, reasoning, decision making.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1401B.1	2	3	0	0	0	0	0	1	2	0	0	0
SH1401B.2	2	0	0	0	0	0	0	1	2	0	0	0
SH1401B.3	2	2	0	0	0	0	0	1	2	0	0	0
SH1401B.4	2	0	0	0	0	0	0	1	2	0	0	0
SH1401B.5	2	2	0	0	0	0	0	1	2	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1401C	Course Category	OE1
Course Name	Nanotechnology, Science and Application		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	20	00

Course Objectives:

Students will be able to:
1. To understand the history, background and nature of Nano science and nanotechnology as well as the quantum and Nano sized scale effect on materials.
2. To acquire theoretical understanding of different types of nanostructure
3. To understand the synthesis technique and its types.
4. To learn the different methods of characterization.
5.Aim to approach towards advance research and application of nanoparticals.

Course Contents:

Basics of Nanoscience:

Introduction, Effect of reduction of dimensions on physical properties, History of Nanotechnology, Quantum size effect,

Different classes of Nanomaterial's:

Classification based on dimensionality-Quantum Dots, Wells and Wires, preparation of quantum nanostructures, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states, exitons, single electron tunnelling.

Material Synthesis Method:

Nanostructures of one dimension: Crystalline growth, Template based synthesis. Nanostructures of two dimensions: Fundamentals of thin film growth, physical vapour deposition, chemical vapour deposition, atomic layer deposition, self-assembly, Sol-Gel films, and electrochemical deposition.

Material Characterization Methods:

UV visible microscopy, Scanning electron microscopy (SEM), Transmission electron microscope (TEM), x-ray diffraction (XRD). Atomic Force Microscope (AFM)

Application of Nanomaterial's:

Agriculture field, Medical field, Space Technology, Food Technology, Water Treatment, Energy Sector, Automobile, Electronics Field, Textile Field, Cosmetic.

Textbooks:

1. Introduction to Nanotechnology by C.P. Poole Jr. and F.J. Oweus, Wiley Interscience
2. Nano-Technology by Gregory Timp (Editior), AIP Press, Springer.
3. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd.

Reference Books and website links:

1. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press
2. Graphene: Synthesis and applications, edited by Wonbong Choi and Jo-won Lee.
3. Semiconductor Nanostructures and Nanodevices Vol 1-5-A. A. Balandin, K. L.Wang.
4. Springer Handbook of Nanotechnology: Bharat Bhushan
5. Nanofabrication towards biomedical application: Techniques, tools, Application and impact: Ed. Challa S., S. R. Kumar, J. H. Carola
6. A. S. Edelstein and R. C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Pub., 1998.
7. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications , Imperial College Press, 2004.

8. G.A. Ozin and A.C. Arsenault, "Nano chemistry : A chemical approach to nanomaterials", Royal Society of Chemistry, 2005.
9. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2001.
10. K.W. Kolasinski, "Surface Science: Foundations of Catalysis and Nanoscience", Wiley, 2002.
11. Physical Chemistry – Atkins Peter, Paula Julio.
12. Nanotechnology in Biology and Medicine: Methods, Devices, and Applications.

Course Outcomes:

On completion of the course, students will be able to:

SH1401C.1: To learn basic of Nano science with special, emphasize on nanomaterial's.
SH1401C.2: Correlate physical behavior of materials at the Nano scale.
SH1401C.3: Understand the physical, chemical and other important methods for synthesis of nanoparticles.
SH1401C.4: Understand the various characterization techniques of Nano materials.
SH1401C.5 Apply the knowledge gained to suggest different applications of Nano science and technology.

CO – PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1401C.1	2	0	2	0	0	0	0	0	1	2	2	3
SH1401C.2	3	2	3	0	2	0	2	0	0	3	2	3
SH1401C.3	3	2	3	2	0	0	3	3	1	3	3	3
SH1401C.4	3	2	3	2	2	0	2	0	0	3	3	3
SH1401C.5	3	2	3	2	2	0	3	1	0	3	3	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH1401D	Course Category	OE1
Course Name	Geoinformatics		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	20	00

Course Objectives

To make the students aware and understand:

1. The fundamental concepts of Geoinformatics, including Geographical Information Systems (GIS), Remote Sensing (RS), and Global Positioning Systems (GPS).
2. The functionalities and applications of various Remote Sensing and GIS software.
3. The importance of data acquisition, database development, and analysis in a GIS environment.
4. The significance of spatial data structures, GIS analysis, and pre-processing techniques.
5. The real-world applications of Geoinformatics in engineering fields through case studies.

Course Contents;

Fundamentals of Remote Sensing: Principles of Remote Sensing and Electromagnetic Radiation (EMR). Interaction mechanisms of EMR with the Earth's surface and image formation. Types and characteristics of sensors and platforms used in Remote Sensing.

Remote Sensing Data Analysis: Types of satellite data products in visible and other bands. Multiband concept and spectral signatures for different Earth features. Visual image interpretation and digital image processing methods. Basics of Photogrammetry and its Applications in Remote Sensing.

Global Positioning System: Fundamentals of GPS technology. Working principles of satellite-based navigation systems. Applications of GPS in mapping, navigation, and surveying.

Geographic Information System (GIS): Components of GIS: Hardware, software, data, and users. Methods of spatial data acquisition and attribute data management. Pre-processing, storage, and database management in GIS. Raster and vector data structures and their significance. GIS analysis functions and spatial queries.

Applications of Geoinformatics in various fields of Engineering including hands on exercises.

Text Books:

1. James B. Cambell, 'Introduction to Remote Sensing', Taylor & Francis.
2. John R Jensen, 'Introductory Digital Image Processing: A Remote Sensing Perspective', Prentice Hall, New Jersey
3. M. Anji Reddy, 'Text book of Remote Sensing and GIS', BS Publications

Reference Books:

1. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman Remote Sensing and Image Interpretation, 7th Edition, Wiley Publication
2. George Dr. Joseph Fundamentals of Remote Sensing, University Press.

Course Outcomes (COs):

On completion of the course, students will be able to:

SH1401D.1	Explain the fundamental principles of Remote Sensing, GIS, and GPS
SH1401D.2	Apply knowledge of data acquisition, pre-processing, and GIS database management.
SH1401D.3	Utilize different Remote Sensing and GIS software for spatial analysis and visualization.
SH1401D.4	Analyses and interprets multispectral remote sensing data for practical applications.
SH1401D.5	Implement GIS-based solutions for various engineering applications including environmental monitoring, urban planning, and disaster management.

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1401D.1	3	2	1	0	1	2	2	1	0	1	0	2
SH1401D.2	3	3	2	2	2	2	2	1	0	1	0	2
SH1401D.3	3	3	3	3	3	2	2	0	0	1	0	2
SH1401D.4	3	3	3	3	3	2	3	0	2	3	2	2
SH1401D.5	3	3	3	3	3	2	3	0	2	3	2	2

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	EE1404							Course Category		PC
Course Name	ELECTRICAL MACHINES-I LABORATORY									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make the students aware and understand:

1. Various parts of d.c. machine and transformer
2. Operation and performance of dc motors
3. Testing of dc machines and transformers

Minimum Eight hands-onexperimentsrelatedtothecoursecontentsofEE1401 Electrical Machines- I to be performed. Representative list is as follows:

1. To identify and understand the functions of various parts of d.c. machines
2. To plot the OCC of d.c. generator
3. To find the critical speed of the d.c. generator
4. To perform and verify the speed control method of d.c. shunt motor
5. To perform the Swinburne test on d.c. machine
6. To perform the load test on d.c. series generator
7. To perform the load test on d.c. series motor
8. To perform the load test on d.c. shunt generator
9. To perform the load test on d.c. shunt motor
10. To perform the load test on d.c. compound generator
11. To perform the load test on d.c. compound motor
12. To perform the test/tests on d.c. machine to separate the losses at constant speed
13. To perform the Hopkinson's Test on d.c. machines
14. To perform the Field test on the d.c. machines
15. To perform the Sumpner's Test on single phase transformer
16. To identify and understand the functions of various parts of the three-phase transformer
17. To perform the OC and SC test on three phase transformer

18.To perform the direct loading test on three phase transformer
19.To perform the various connections of three phase transformer
20.To study the Scott connection of transformer
21.To perform OC and SC test on single phase transformer

Course Outcomes:

After completion of the course, the students will be able to –

EE 1404.1 Identify and understand the functions of various parts of d.c. machines

EE 1404.2 Plot various characteristics of dc machines

EE 1404.3 Test dc machines and transformers

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1404.1	2	-	-	-	-	-	-	1	2	-	-	-	2	1	1
EE1404.2	2	-	-	-	-	-	-	1	2	-	-	-	2	1	1
EE1404.3	2	2	-	-	-	-	-	1	2	-	-	-	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1405							Course category			PC
Course Name	MICROPROCESSOR AND MICROCONTROLLER LABORATORY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

Students will be able to:

1. Understand the functional hardware components of a microprocessor and microcontroller.
2. Explore the programming skills for microcontroller-based system.
3. Interface various external devices with microcontroller.

Minimum Eight Experiments to be performed covering the entire Syllabus of EE1402 Microprocessors and Microcontrollers. Representative list is as follows:

1. Write a program to store data into given RAM memory locations using direct and indirect addressing modes.
2. N 8 bit numbers stored in internal data memory write a program to arrange the numbers in descending order and ascending order.
3. Write a program to create a delay of 1000 ms. Assume that the oscillator frequency is 12 MHz.
4. Write a program to toggle alternate bits at port 1.
5. Write a program to receive 8 bits data from port0 and port1. Perform AND operation of the received data and send the results to port2.
6. Write a program for Hexadecimal up counter.
7. Interface DAC and write program to generate square wave.
8. Write a program to start A/D converter and store the results in accumulator.
9. Write a program to interface LCD.
10. Write a program to interface LED.

ICA: Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment-wise by using continuous assessment formats, A and B.

ESE: The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

After completion of the course, the students will be able to:

EE1405.1 Design the microcontroller-based systems.

ET1405.2 Develop the programs in assembly/C language for a microcontroller-based system.

ET1405.3 Demonstrate the skills to interface the external devices with microcontrollers.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1405.1	3	1	1	3	0	0	0	0	0	0	0	0	1	3	0
EE1405.2	3	3	3	2	2	0	0	0	0	0	0	0	2	3	0
EE1405.3	3	3	3	2	3	0	0	0	0	0	0	0	2	3	0

0- Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	EE1406	Course Category	VSE
Course Name	POWER ELECTRONICS LABORATORY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

The students will be able to:

1. Plot characteristics of various power semiconductor devices
2. Know functioning of various power converters
3. Perform simulation of power converters to get desired output

Minimum Eight Experiments should be performed covering the entire syllabus of EE1403, Power Electronics course. Representative list is given as follows:

Any THREE from 1 to 5

1. SCR/ GTO Characteristics.
2. SCR Turn-on methods.
3. SCR Commutation methods.
4. IGBT / MOSFET Characteristics, Drivers.
5. TRIAC – Triggering modes and Phase control.

AnyTHREE from 6 to 10

6. Single-phase Half / Full Controlled Converter.
7. Single-phase Dual Converter.
8. Thyristorised / Transistorized D.C. Chopper.
9. Single phase Thyristorised / Transistorised Inverter.
10. Single phase Cycloconverter / A.C. Regulator.

Any TWO from 11 to 15

11. Simulation of Converter/ Chopper.

12. Simulation of Inverter / Cycloconverter.

13. Simulation of Triggering Scheme / PWM Technique.

14. Switched mode Converter/ Rectifier.

15. Uninterruptible Power Supply.

ICA: Internal Continuous Assessment shall be based on the practical record and knowledge / skills acquired. The performance shall assess experiment-wise by using continuous assessment formats, A and B.

ESE: The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

EE1406.1 Select appropriate semiconductor device for building a power converter

EE1406.2 Develop the power converter required for given application.

EE1406.3 Simulate the power converter before its prototype.

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1406.1	2	1	0	0	0	0	0	0	0	0	0	0	1	2	1
EE1406.2	1	1	2	2	1	0	0	0	0	0	0	0	1	2	1
EE1406.3	0	1	1	2	2	0	0	0	0	0	0	1	1	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

EXIT COURSES (After B. Tech. II Year)

Course Code	EE1411	Course category	EX
Course Name	INDUSTRIAL AUTOMATION		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
--	--	--	--	--	--	--	--	--	50	--	50	04

Course Objectives:

To make the students aware and understand:

1. Need & Requirement of automation.
2. Concept of control system.
3. Concept of Programmable logic controller.

Course Contents:

Automation

Need of automation, Advantages of automation, Requirements of automation.

Control System

Concept of control system, Basic block diagram of control system, Transfer function, Different terms in control system, Types of control system, Applications of control system, Development of block diagram for simple applications like level, temperature, flow control.

Control System Components

Contacts-types, current capacity & load utilization categories, Solenoids-dc, ac , I/P devices- switches-push buttons, foot switch, selector switch, pilot switch, proximity, photoelectric, temperature actuated, level control, pressure sensing, overload sensing, Relays- electromechanical, reed O/P devices- contactors, valves, pilot lamps, Symbols in power & control circuits, Developing control circuit-basic & thumb rule. Power & control circuit for different applications like hoist, crane, conveyer belt, induction motors.

Control System Components

Contacts-types, current capacity & load utilization categories Solenoids-dc, ac I/P devices- switches-push buttons, foot switch, selector switch, pilot switch, proximity,

photoelectric, temperature actuated, level control, pressure sensing, overload sensing, Relays- electromechanical, reed O/P devices- contactors, valves, pilot lamps, Symbols in power & control circuits, Developing control circuit-basic & thumb rule ,Power & control circuit for different applications like hoist, crane, conveyer belt, induction motors .

Electrical Actuators

Potentiometers-working & use as error detector, Servomotors-ac & dc –working principle, Synchros - transmitter, control transformer, use of as error detector, Stepper motor-PM & variable reluctance- working principle Tacho – generator, Applications of above components as AC/DC control system.

Controllers

Hydraulic-advantages & disadvantages, hydraulic servomotor, types of pumps used, control valves, components like accumulator, filter, seals Pneumatic-resistance & capacitance of pressure system, pneumatic flapper-nozzle system, pneumatic relays, actuating valves, cylinders, comparison between pneumatic & hydraulic systems, Electrical & electronic controller-brief overview of op-amps, inverting, non-inverting, lead-lag networks, Digital controllers-brief overview of microprocessor & micro-controller to be worked as controller.

Control actions

On-Off, P, I, P+I, P+D,P+I+D, actions, P+I+D action using hydraulic, pneumatic electronic controller Tuning of P+I+D controller.

Programmable Logic Controller

Introduction, Advantages & disadvantages, PLC vs PC, Block diagram of PLC, Basic blocks like CPU, I/O modules, bus system, power supplies & remote I/Os, Different PLCs available in market.

Programming of PLC

Development of Ladder logic, some simple programs such as I/O connections, starting of IM, stepper motor control.

Introduction to special control systems

Distributed Control System (DCS) - brief introduction to hardware & software used, SCADA- brief introduction to hardware & software used.

Text Books:

1. Nagrath & Gopal , Control System Engineering, Wiley Eastern
2. K. Ogata, Modern Control System, Prentice Hall
3. Andrew Parr, Hydraulics & Pneumatics, Jaico Publication

Reference books:

1. Webb & Reis, Programmable Logic Controller: Principle applications, Wiley Eastern
2. S.K. Bhattachrya & Brijinder Singh, Control of Electrical Machines Control of Electrical Machines, New Age International Publishers
3. Jacob, Industrial Control Engineering, Prentice Hall

Course Outcomes:

At the end of this course, students will demonstrate the ability to

EE1411.1	Explain applications of control system/Automation
EE1411.2	Read and design data for control system
EE1411.3	Explain the hydraulic/ pneumatic systems
EE1411.4	Describe & program PLC using Ladder logic
EE1411.5	Draw power & control circuit

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1411.1	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1411.2	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1411.3	2	-	-	-	1	1	1	-	-	-	-	-	1	-	-
EE1411.4	2	-	-	-	-	1	2	-	-	-	-	-	2	-	-
EE1411.5	2	-	-	-	1	1	2	-	-	-	-	-	2	-	-

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	EE1412	Course Category	EX
Course Name	ELECTRICAL ESTIMATING AND COSTING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
--	--	--	--	--	--	--	--	--	50	--	50	04

Course Objectives:

To make the students aware and understand:

1. The importance of estimation, specification and earthing
2. The schedule of materials with specifications and estimates for service mains.
3. The students to prepare the schedule of materials with specifications and estimates for different types of electrical installations.

Course Contents:

Introduction

Meaning of estimation, purpose of estimating and the factors to be considered while preparing estimations, qualities of a good estimator, Meaning of specification, importance of specification and the factors to be considered. Meaning of standardization and its advantages. Meaning of overhead charges, stock incidental charges, contingencies, supervision charges, labour charges, Inspection/Inspectorate charges, transportation charges and miscellaneous charges. Meaning of tender/tender notice, quotation, comparative statement, purchase order and work order. Importance/ purpose of IE Act and IE Rules.

Meaning of earthing, touch potential and step potential, necessity of earthing, Points to be earthed, factors influencing earth resistance, methods of reducing earth resistance, standard values of earth resistance for various installations, method of selecting the size of earth conductor, types /methods of earthing, Pipe earthing-diagram, specifications of pipe earthing, Plate earthing-diagram and specifications of plate earthing.

Service Mains

Meaning of service mains, code of Practice for service mains, types of service mains- Over Head Service Mains -materials and specifications, UG Service Mains -materials and specifications, Standard wire size table, current ratings for Aluminum, copper conductors and selection of size of conduit pipe as per the size and number of wires.

Load calculation, selection of size and type of conductor/UG cable, discrimination of size of protective devices, Quantity calculation, schedules of materials and estimates for single phase OH service connection, three phase OH service connection, single phase UG service connection and three phase UG service connection.

Lighting Installations

Interior Wiring types and their applications, factors to be considered while selecting the type of wiring system, materials required for Interior wiring and their specifications, Code of Practice for Lighting Installations, method of deciding the number of sub-circuits, calculating the quantity of wiring materials and accessories for the Interior Wiring, load calculations for a residential buildings, size of conductors, main switch, sub switches and protective devices. Draw wiring plan for AEH Installation, concept of horizontal run, vertical rise and vertical drop. Prepare the schedule of materials for providing lighting and heating circuits and their estimates. Procedure for converting lighting to AEH installation

Power Installations

Code of Practice for Power Installations, materials required for power circuit wiring and their specifications, Prepare the layout diagram of machines showing clearances as per IS standards, draw wiring plan of the Power circuit for workshops, Decide the type of wiring.

System, load calculations, determine the size of conductors, main switch, Isolators, sub switches and protective devices, Draw the SLD of Power Distribution Scheme showing grading/discrimination of ratings of protective devices, Prepare the schedule of materials with specifications for workshops and their estimates, Determine the rating of motor for IP set and the concept (only)of pump house wiring.

Distribution Lines and Transformer Substations Code of practice for Distribution Lines and Transformer centre, types of transformer centres - Pole mounted, plinth mounted, indoor and outdoor types. Determining the rating of distribution Transformer. Write Specifications of the Distribution Transformer. Draw the SLD of a Transformer centre indicating the size of protective devices, Prepare the schedule of equipments /Materials with specifications for a 11KV/415V,100 KVA transformer centre and their estimates, 415 V LT line materials and specifications , method of calculating various LT line materials (only). Prepare the schedule of materials (only) for 3 phase 4 wire LT line, 11 KV HT Line-materials and their specifications, method of calculating various HT line materials and tapping structure, TOPO sheet and its use, Concept of combined estimates. Prepare the schedule of materials (only) for 11 KV single circuits. HT line for Rural Electrification.

Transmission Lines and Substations

Code of practice for Transmission lines and substations, transmission line materials and their specifications, types of Towers, ACSR conductors and Number of Disc insulators in suspension string, strain string, span and height of towers for 66 KV, 110 KV, 220 KV transmission lines, concept of single circuit and double circuit transmission lines, method of calculating the Quantity of transmission line materials, Prepare the schedule of materials (only) for 66 KV,110 KV and 220 KV single circuit transmission lines. 66KV/11KV, 5 MVA Substations- Single Line diagram, list of Electrical equipment/ materials (only) and their specifications.

Text Books:

1. Electrical Design Estimating and Costing, Raina. K. B. & Bhattacharya. S. K., New Age International.

Reference Books:

1. A Course in Electrical Installation, Estimating & Costing, J. B. Gupta, S. K. Kataria & Sons.
2. Electrical estimating and costing, Surjith Singh, Dhanpat Rai & Co.

Course Outcomes:

On completion of the course, students will be able to:

EE1412.1	Understand various types of materials required for wiring.
EE1412.2	Comprehend the estimation of a domestic installation.
EE1412.3	Know different systems of earthing.
EE1412.4	Comprehend the estimation of industrial installations.
EE1412.5	Comprehend the estimation of substations

CO – PO – PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1412.1	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1412.2	2	-	-	-	1	1	1	-	-	-	-	-	2	-	-
EE1412.3	2	-	-	-	1	1	1	-	-	-	-	-	1	-	-
EE1412.4	2	-	-	-	-	1	2	-	-	-	-	-	2	-	-
EE1412.5	2	-	-	-	1	1	2	-	-	-	-	-	2	-	-

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SEMESTER - V

Course Code	EE1501	Course Category	PC
Course Name	ELECTRICAL POWER - I		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	Total
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Modelling of transmission lines
2. Appreciate use of per unit quantities in power system analysis
3. Obtain Steady state solution of power system using Load Flow Methods

Course Contents:

General Structure of Electrical Power System - Introduction to Power System, Generation, Transmission, Distribution and Utilization- Overview, Single Line Diagram (SLD) Representation Transmission , Synchronous Grids and Asynchronous (DC) interconnections.

Transmission Lines - Types of Transmission Lines, Basic Concept of Inductance and Capacitance of Transmission Lines, Modes of Short, Medium, Long Transmission Lines, A, B, C, D Parameters, Per Unit System- Necessity, Advantages, Applications in Power Systems and Calculations, Transmission Line Voltage Control Methods

D.C. and A. C. Distribution - Types of dc distributors, dc distribution calculations, ac distributor, fed at one and fed at both the ends with concentrated loads and uniformly distributed loads, ring distributors with inter connectors, current distribution in three wire and four wire ac systems, overview of distribution automation.

Load Flow Analysis - Formation of bus admittance matrix, real and reactive power balance equations at a node. Load and generator specifications. Application of numerical methods for solution of non- linear algebraic equations – Gauss Seidel and Newton – Raphson methods for the solution of the power flow equations

Control of Frequency and Voltage - Turbines and speed-governors, frequency dependence of loads, droop control and power sharing. Automatic generation control. Generation and absorption of reactive power by various components of a power system. Excitation system control in synchronous generators, automatic voltage

regulators. Shunt compensators, Static VAR compensators and STATCOMs, tap changing transformers.

Text Books:

1. I. J. Nagrath, D. P. Kothari, Power System Engineering, Tata McGraw-Hill publications, 2008.
2. Electrical Power System, Ashfaq Hussain fifth edition CBS Publishers and Pvt. Ltd. Fifth Edition.

Reference Books:

1. Prabha Kundur, Power System Analysis and Control, TMH, 2008.
2. O. I. Elgerd, Electric Energy Systems Theory, McGraw-Hill publications, 1971.
3. John J Grainger, W. D. Stevenson, Power System Analysis, McGraw-Hill (India) Pub., 2003
4. Hadi Saadat, Power System Analysis, TMH , 2002.

Course Outcomes:

On completion of the course, students will be able to:

EE1501.1 Understand the Model transmission lines and other power system component.
EE1501.2 Analyze the reactive power requirement, voltage profile along the line and VAR compensation..
EE1501.3 Analyse Obtain Steady state solution of power system using G-S Load Flow.
EE1501.4 Compare Investigate the stability of the system using Swing Equation.
EE1501.5 Comprehend the generation of over-voltages and insulation coordination.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1501.1	2	2	0	1	2	0	0	0	0	0	0	1	1	1	1
EE1501.2	2	1	2	2	2	0	0	0	0	0	0	1	1	2	2
EE1501.3	1	3	0	2	2	0	0	0	0	0	0	1	1	3	2
EE1501.4	1	3	2	2	2	0	0	0	0	0	0	1	2	2	2
EE1501.5	1	1	2	3	2	0	0	0	0	0	0	1	1	1	3

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1501.1	2	2	0	1	2	0	0	0	0	0	1	1	1	1
EE1501.2	2	1	2	2	2	0	0	0	0	0	1	1	2	2
EE1501.3	1	3	0	2	2	0	0	0	0	0	1	1	3	2
EE1501.4	1	3	2	2	2	0	0	0	0	0	1	2	2	2
EE1501.5	1	1	2	3	2	0	0	0	0	0	1	1	1	3

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Course Code	EE1502	Course Category	PC
Course Name	ELECTRICAL MACHINES - II		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	Total
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Basic concept of AC machine winding and revolving magnetic field
2. Operation and testing of Induction machine (single and three-phase)
3. Construction, Operation and testing of synchronous machines, Modelling of transmission lines.

Course Contents:

Synchronous Machines-I

Alternator: Working Principle and Construction of Alternator, Armature Windings, Distribution Factor and Pitch Factor, Equation of Induced E.M.F. Alternator on Load, Synchronous Reactance Vector Diagrams of Loaded Alternator, Voltage Regulation, Direct Loading Method, EMF method, Ampere-turn, Potier Method. Operation of Salient Pole Alternator, Power Developed by Alternator, Parallel Operation of Alternators Distribution of Load, Synchronizing of Alternators Connected to Infinite Bus-bars Synchronizing Torque

Synchronous Machines-II

Synchronous Motor: General Principle of Operation Method of Starting, Motor on Load with Constant Excitation, Power Flow, Equivalent Circuit, Power Developed by a Synchronous Motor. Operation with Different Excitations, Effect of changing Excitation and changing load, Construction of V-curves, Hunting Phase Swinging, Synchronous Motor Applications

Induction Machines

Concept of rotating magnetic field, Construction and working principle, 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). Testing of induction motor and circle diagram, Methods of starting, and speed control for induction motors. Generator operation.

Single-Phase Induction Motors

Constructional features double revolving field theory, equivalent circuit, and determination of parameters. Split-phase starting methods and applications

Text Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
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 & Sons

References Books:

1. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Course Outcomes:

On completion of the course, students will be able to:

EE1502.1 Know the concepts of rotating and pulsating magnetic field.
EE1502.2 Understand the operation and construction of ac machines.
EE1502.3 Investigate the performance of ac machines.
EE1502.4 Evaluate the steady state behaviour and operating characteristics of AC machines
EE1502.5 Analyse performance of IM graphically.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1502.1	2	2	0	2	0	0	0	0	0	0	0	0	2	2	0
EE1502.2	2	3	1	2	0	0	0	0	0	0	0	0	3	0	2
EE1502.3	2	2	1	2	0	0	0	0	0	0	0	0	2	2	0
EE1502.4	3	2	1	0	0	0	1	0	0	0	0	0	3	0	0
EE1502.5	1	1	1	0	0	0	0	0	0	0	0	0	2	0	2

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1502.1	2	2	0	2	1	0	0	0	0	0	0	2	2	0
EE1502.2	2	1	1	2	0	0	0	0	0	0	0	1	0	2
EE1502.3	2	2	1	2	0	0	0	0	0	0	0	2	2	0
EE1502.4	2	2	1	0	1	0	1	0	0	0	0	3	0	0
EE1502.5	1	1	1	0	0	0	0	0	0	0	1	2	0	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1503	Course Category	PC
Course Name	CONTROL SYSTEMS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	Total
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Formulation of mathematical model of LTI system
2. Analyse the control system in time domain, frequency domain and in state space
3. Investigate the stability of control systems

Course Contents:

Introduction to control problem

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Time Response Analysis

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Frequency-response analysis

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

State Variable Analysis

State, state space and state variables; SISO/MIMO linear systems state variable models - differential equations, Transfer Functions, Block Diagrams and State Diagrams (Signal Flow Graphs); Transfer functions decomposition - Phase variable forms, Canonical

forms and Jordan canonical form; Transfer function - state model; Transfer matrix; State equations solution - State transition matrix (STM); STM Computation – Laplace transformation, Canonical transformation and Cayley Hamilton theorem; Time response – SISO Systems. Concept - controllability and observability; SISO/MIMO Linear systems - Gilbert's method and Kalman's test.

Text Books:

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

References Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997

Course Outcomes:

On completion of the course, students will be able to:

EE1503.1 Formulate mathematical model of LTI systems using TF and state space representation.
EE1503.2 Explore control systems in time domain and frequency domain.
EE1503.3 Understand the concept of stability and assessment for LTI systems.
EE1503.4 Represent the linear discrete-time systems by State-space models.
EE1503.5 Design simple feedback controllers.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1503.1	3	1	1	3	0	0	0	0	0	0	0	0	1	3	0
EE1503.2	3	3	3	2	2	0	0	0	0	0	0	0	2	3	0
EE1503.3	3	3	3	2	2	0	0	0	0	0	0	0	2	3	0
EE1503.4	3	3	1	3	3	0	0	0	0	0	0	0	0	2	0
EE1503.5	3	3	2	3	1	0	0	0	0	0	0	0	0	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1503.1	3	1	1	3	0	0	0	0	0	0	0	1	3	0
EE1503.2	3	3	3	2	2	0	0	0	0	0	0	2	3	0
EE1503.3	3	3	3	2	2	0	0	0	0	0	0	2	3	0
EE1503.4	3	3	1	3	3	0	0	0	0	0	0	0	2	0
EE1503.5	3	3	2	3	1	0	0	0	0	0	0	0	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1504A	Course Category	PE
Course Name	ELECTRICAL MACHINE DESIGN		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	Total
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2hrs. 30min.	--	--	100	04

Course Objectives:

To make the students aware and understand:

1. Challenges in efficient and cost-effective electrical machine design
2. Design procedures for various electrical machines
3. Computer aided design approach for optimal electrical machine design.

Course Contents:

Introduction:
Major considerations in electrical machine design, electrical engineering Materials, space factor. Choice of specific electric and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Transformers:
Sizing of a transformer, main dimensions, kVA output for single- and three- phase transformers, window space factor, overall dimensions, operating characteristics, regulation' no road current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Induction Motors:
Sizing of an induction motor, main dimensions, length of air gap, rulesfor selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor. magnetic leakage calculations, Leakage reactance of poly phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Synchronous Machines:
Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation

of air gap length, design of rotor, design of damper winding, determination of furl road field mmf, design of field winding, design of turbo alternator, rotor design.

Computer aided Design (CAD):
Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based Machine Design, Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text Books:
1. A. K. Sawhney, "A Course in Electrical Machine Design" Dhanpat Rai and Sons, 1970
2. M. G. Say, "Theory Performance and Design of AC Machines", ELBS London

References Books:
1. K. Sen, "Principles of Electrical Machine Design with computer programs", Oxford and IBH Publishing, 2006.
2. K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satyaprakashan, 1969.
3. Shanmuga Sundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
4. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B. S. Publications, 2008.
5. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Course Outcomes:
On completion of the course, students will be able to:

EE1504A.1	Understand the construction and performance characteristics of electrical Machines
EE1504A.2	Analyze the effect of various factors which influence the design, electrical, magnetic and thermal loading of electrical machines
EE1504A.3	Apply the principles of electrical machine design and carry out a basic design of electrical machines.
EE1504A.4	Comprehend various approaches for computer aided design of electrical Machines
EE1504A.5	Use software tools to do design calculations

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1504A.1	3	2	3	0	0	0	0	0	0	0	0	0	3	2	0
EE1504A.2	3	3	3	2	2	0	1	0	0	0	0	0	3	0	0
EE1504A.3	3	3	3	3	2	1	1	0	0	0	0	0	3	3	0
EE1504A.4	2	1	2	1	2	0	0	0	1	0	0	0	1	0	0
EE1504A.5	3	0	0	0	0	0	0	0	0	0	0	0	2	1	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1504A.1	3	2	3	0	0	0	0	0	0	0	0	3	2	0
EE1504A.2	3	3	3	2	2	0	1	0	0	0	0	3	0	0
EE1504A.3	3	3	3	3	2	1	1	0	0	0	0	3	3	0
EE1504A.4	2	1	2	1	2	0	0	0	1	0	0	1	0	0
EE1504A.5	3	0	0	0	0	0	0	0	0	0	0	2	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1504B	Course Category	PE
Course Name	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
04	-	-	04	15	15	10	60	2hrs. 30min.	-	-	100	04

Course Objectives:

To make the students aware and understand:

1. Electrical power system and tariffs in India.
2. Need and Importance of energy saving practices in electrical utilities.
3. Energy saving opportunities in drives, fans, pumps, lighting, DG sets, etc.

Course Contents:

Introduction to Electrical systems: Introduction to Electrical energy systems, Tariff and economic considerations, T & D losses, Electrical load and various factors, Power factor and its introductory improvement techniques, Energy Efficient Technologies in Electrical Systems

Electric Motors and Drives: Energy Efficient Motors, Factors affecting Energy efficiency of a motor Introduction to power electronic controllers, soft starters and block diagrams of stator voltage and stator frequency controlled three phase induction motor drives, block diagrams of controlled rectifier and chopper fed dc shunt motor.

Fans and Blowers: Types, efficient system operation, Capacity selections, Performance assessment of fans and blowers, Energy conservation opportunities

Pumping systems: Types, Performance evaluation, efficient system operation, Energy conservation opportunities in pumping systems

Lighting systems: Basic terms of lighting systems recommended illumination level, Methodology of lighting systems, energy efficiency study, and Energy conservation opportunities.

DG Set and UPS systems: Introduction, Selection and capacity factor, Operational parameters, Performance assessment of DG Systems, Energy conservation opportunities, Block diagram and working of UPS Energy Efficiency in Renewable Energy Systems: Energy efficiency in solar and wind energy systems.

Text Books:

1. Doty S. and Turner W. C. (2012); Energy Management Handbook, Eighth Edition, Fairmont Press
2. Bureau of Energy Efficiency (BEE) (2012); Study material for Energy Managers and Auditors Examination: Paper I to IV
3. Bureau of Energy Efficiency (BEE) (2015); Electrical Efficiency in Electrical Utilities-Book3

Reference Books:

1. Thumann A. and Mehta D. P. (2008); Handbook of Energy Engineering, Sixth Edition, Fairmont Press
2. Capehart B. L. Turner W. C. and Kennedy W. J. (2011); Guide to Energy Management, Seventh Edition. Fairmont Press
3. Kao C. (1999); Energy Management in Illumination System, First Edition, CRC Press

Web Resources:

1. http://www.nptel.iitm.ac.in
2. http://www.ocw.mit.edu

Course Outcomes:

On completion of the course, students will be able to:

EE1504B.1 Understand the components of electrical energy systems.
EE1504B.2 Apply energy efficient technologies in electrical utilities..
EE1504B.3 Utilize the various energy conservation techniques and practices.
EE1504B.4 Evaluate the performance of various types of electrical loads..
EE1504B.5 Select the proper capacity of various equipment's/accessories for given applications.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1504B.1	2	1	0	0	0	0	0	0	0	0	0	0	2	2	0
EE1504B.2	2	2	1	0	2	0	2	0	0	0	0	0	3	2	0
EE1504B.3	2	2	1	1	2	1	0	0	0	0	0	2	3	1	0
EE1504B.4	3	2	0	0	0	0	1	0	0	0	0	0	3	2	0
EE1504B.5	3	0	0	0	3	0	1	0	0	0	0	0	3	1	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1504B.1	2	1	0	0	0	0	0	0	0	0	0	2	2	0
EE1504B.2	2	2	1	0	2	0	2	0	0	0	0	3	2	0
EE1504B.3	2	2	1	1	2	1	0	0	0	0	2	3	1	0
EE1504B.4	3	2	0	0	0	0	1	0	0	0	0	3	2	0
EE1504B.5	3	0	0	0	3	0	1	0	0	0	0	3	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1504C	Course Category	PE
Course Name	ELECTRIC AND HYBRID ELECTRIC VEHICLES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Th					Tu		Total	Total
				CT1	CT1	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2hrs. 30min.	--	--	100	04

Course Objectives:

To make the students aware and understand:

1. Electric Vehicle Technology
2. Various components in EV/HEV
3. Functions of drive trains in EV/HEV

Course Contents:

Introduction to Electric Vehicles: History of EV, Current Major Issues, Social and Environmental Importance of EV and Hybrid Vehicle, Recent Development Trends, EV Concept, Key EV Technology, Comparison of EV with IC Engine vehicle.

EV System: EV Configuration: Fixed & variable gearing, single & multiple motor drive, In- wheel drives, EV Parameters: Weight, size, force, energy & performance parameters. Understanding electric vehicle components, Basic EV components and architecture, fuel efficiency analysis, Vehicle to Grid and Vehicle to home concept

Electric Drive Trains (EDT) – basic concept of electric traction, Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling.

Power Electronics and Electric Propulsion EV: Control of DC motor drive, Control of Induction motor drive, Permanent Magnet Motor drive, Switch reluctance motor drive, Sensors, concept of Autonomous EV cars.

Hybrid Electric Vehicles: Concept of Hybrid Electric Vehicles (HEV), Classification – Micro EHV Mild EHV, Full EHV, Plug-in EHV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid EV, Propulsion systems and components, Power flow control in hybrid drive-train topologies, Regenerative Braking, Introduction to energy storage.

Text Books:

1. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.
2. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, Taylor and Francis group, 2015.

Reference Books:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017.
3. Jack Erjavec and Jeff Arias, "Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles", Cengage Learning Pvt. Ltd., New Delhi, 2007.
4. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley, 2003.
5. Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, theory and design, Mehrdad Ehsani, Yimi Gao, Ali Emadi, CRC Press, 2005.

Web Resources:

1. Fundamentals of Electric vehicles: Technology and Economics, NPTEL Course (Link: https://nptel.ac.in/courses/108/106/108106170/)
2. Electric Vehicles- Part I, NPTEL Course (Link: https://nptel.ac.in/courses/108/102/108102121/)

Course Outcomes:

On completion of the course, students will be able to:

EE1504C.1 Explain the working and types of EV and HEV.

EE1504C.2 List the components of EV and HEV

EE1504C.3 Analyze the drive trains for Electric and Hybrid electric vehicles.

EE1504C.4 Explain the Power electronics and electric propulsion in EV.

EE1504C.5 Classify different Hybrid Electric vehicles.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1504C.1	2	2	0	0	0	1	0	0	0	0	0	0	2	1	2
EE1504C.2	2	1	1	2	0	0	0	0	0	0	0	0	2	1	2
EE1504C.3	2	3	3	3	2	0	0	0	0	0	0	0	2	0	3
EE1504C.4	1	2	2	0	0	0	1	0	0	0	0	0	2	1	1
EE1504C.5	2	1	2	1	0	0	0	0	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1504C.1	2	2	0	0	0	1	1	0	0	0	0	2	1	2
EE1504C.2	2	1	1	2	0	0	0	0	1	0	0	2	1	2
EE1504C.3	0	3	3	3	2	1	1	0	0	0	0	2	0	3
EE1504C.4	1	2	2	0	2	0	1	0	0	0	0	2	1	1
EE1504C.5	2	1	1	1	2	1	1	0	1	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1505							Course Category		VSE
Course Name	PROFESSIONAL SOFTWARE LAB									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make the students aware and understand:

1. The basics of MATLAB / ETAP/ PSCAD/ Any Open-Source Software
2. Commands and structure of MATLAB programs/ ETAP/ PSCAD/ Any Open-Source Software
3. Simulation using MATLAB/ ETAP/ PSCAD/ Any Open-Source Software

Course Contents:

Minimum two simulations based on Professional Software (Latest Version of MATLAB / Any Open-Source Software) / performance type experiments on each course in the current Semester should be performed. Respective Course Coordinators shall submit all details of Experiments based on concerned course to the Course Coordinator of this course at the beginning of semester.

ICA: Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment-wise by using continuous assessment formats, A and B.

ESE: The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

After completion of the course, the students will be able to:

EE1505.1 Understand command and structure of MATLAB programs
EE1505.2 Write the program in MATLAB
EE1505.3 Simulate the simple Electrical Circuits/Power systems

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CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1505.1	1	1	0	0	0	0	0	1	2	0	0	0	1	1	1
EE1505.2	1	0	0	1	0	0	0	1	1	0	0	0	0	1	0
EE1505.3	1	1	0	0	0	0	0	1	2	0	0	0	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1505.1	1	1	0	0	1	0	0	1	2	0	0	1	1	1
EE1505.2	1	0	1	1	1	0	0	1	1	0	1	0	1	0
EE1505.3	1	1	0	0	1	0	1	1	2	0	0	2	2	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1506							Course Category		VSE
Course Name	ELECTRICAL POWER - I LABORATORY									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make the students aware and understand:

1. Modelling of transmission lines
2. Use of per unit quantities in power system analysis
3. Steady state solution of power system using G-S Load Flow

Course Contents:

Minimum Eight hands-on-experiments related to the course contents of EE1501 Electrical Power - I course to be performed. Representative list is as follows:

1. To determine the inductance (L) per phase per km of unsymmetrical three phase line
2. To determine the inductance of three phase double circuit transmission line.
3. To determine the capacitance of symmetrical three phase transmission line.
4. To find Capacitance of an Unsymmetrical three-phase transposed line.
5. Analyse the reactive power requirement of lines, voltage profile along the line and VAR compensation.
6. To determine A, B, C, D constants of a given transmission line.
7. Ybus formation by observation.
8. To carry out load flow using Gauss-Seidel method
9. To carry out load flow using NR method
10. Simulation of typical power system- familiarization with generator, line and load models.
11. Visit to HV/EHV substation, power generating station.
12. To study EHVAC transmission line simulator.

ICA: Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment-wise by using continuous assessment formats, A and B.

ESE: The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

After completion of the course, the students will be able to:

EE1506.1 Model and simulate single-machine power system for steady state study
EE1506.2 Analyse transmission line parameters (L,C) per kilometer of unsymmetrical and symmetrical line for different configurations
EE1506.3 Analyse the reactive power requirement of lines, voltage profile along the line and VAR compensation

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
EE1506.1	3	2	1	2	3	0	0	0	0	0	0	1	2	1	2
EE1506.2	2	2	1	2	3	0	0	0	0	0	0	1	2	1	2
EE1506.3	2	2	1	2	3	0	0	0	0	0	0	1	2	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1506.1	3	2	1	2	3	0	0	0	0	0	1	2	1	2
EE1506.2	2	2	1	2	3	0	0	0	0	0	1	2	1	2
EE1506.3	2	2	1	2	3	0	0	0	0	0	1	2	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1507							Course Category		PC
Course Name	ELECTRICAL MACHINES-II LABORATORY									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make the students aware and understand:

1. Various parts of a.c. machines
2. Testing, operation and performance analysis of Synchronous Machines
3. Testing, operation and performance analysis of Induction Motor

Course Contents:

Minimum Eight hands-on-experiments related to the course contents of EE1502 Electrical Machines- II to be performed as per IS Code. Representative list is as follows:

1. To Determine the regulation of three phase Alternator by direct loading method
2. To determine the regulation of three phase Alternator by Synchronous Impedance Method
3. To find X_d and X_q of salient pole synchronous machine by slip test
4. To study starting and reversal of direction of rotation of three phase synchronous motor
5. To plot the 'V' and 'Inverted V' curves of synchronous motor
6. Application of synchronous motor as power factor correction device
7. To perform the load test on three phase induction motor and plot its characteristics
8. Perform the No load and short circuit test on three phase Induction motor to find its Equivalent circuit
9. Construction of Circle diagram from the No load and short circuit test Data
10. Speed control of three phase induction motor
11. Study of three phase induction motor starters

12. Running light and locked rotor test on single phase induction motor to find its equivalent circuit.
13. Parallel operation of Alternators (Synchronizing Methods)

ICA: Internal Continuous Assessment shall be based on the practical record and knowledge/ skills acquired. The performance shall be assessed experiment-wise by using continuous assessment formats, A and B.

ESE: The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

After completion of the course, the students will be able to:

EE1507.1 Identify and understand the functions of various parts of a.c. machines

EE1507.2 Plot various characteristics of ac machines

EE1507.3 Test ac machines analyse the performance

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1507.1	2	0	0	0	0	0	0	1	2	0	0	0	1	1	1
EE1507.2	1	0	0	0	0	0	0	1	1	0	0	0	2	1	2
EE1507.3	2	1	0	0	0	0	0	1	2	0	0	0	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1507.1	2	0	0	0	0	0	0	1	2	0	0	1	1	1
EE1507.2	0	0	0	0	1	0	0	1	1	0	0	2	1	2
EE1507.3	1	1	0	1	0	0	0	1	2	0	0	2	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1508	Course Category	PC
Course Name	CONTROL SYSTEM LABORATORY		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make students aware and understand:

1. Develop the mathematical model of different components of linear feedback control system using simulation tools and experiments.
2. Analyse the transient characteristics of different first order and second order systems using simulation and experiments.
3. Determine the performance of system using root locus, Bode plot and Nyquist plot.

Course Contents:

Minimum Eight Experiments to be performed covering the entire Syllabus of EE1503 Control System. Representative list is as follows:

1. To determine transfer function of given D.C. generator
2. To study potentiometers and Synchronous as error detector
3. To determine closed loop response of first order system
4. To determine closed loop response of second order system
5. To obtain root locus experimentally.
6. Use MATLAB to study effect of feedback gain on system response.
7. Use MATLAB to study effect of damping factor zeta on time control performance specifications.
8. Use MATLAB to obtain root locus for a given system and find performance specifications there from.
9. Study effect of addition of zero and pole on root locus
10. Use MATLAB to get Bode plot and obtain gain margin and phase margin for various systems.

11. Use of MATLAB to obtain Nyquist plot &therefrom obtain gain & phase margin for given System
12. Use MATLAB to obtain state space representation from transfer function, find Eigen values, and analyze controllability, observability and stability.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - The End Semester Exam for practical shall be based on performance in one of experiments and may be followed by sample questions.

Course Outcomes:

After completion of the course, the students will be able to:

EE1508.1 Prepare mathematical of control system components.

EE1508.2 Analyse transient characteristics of first and second order systems.

EE1508.3 Determine performance of LTI systems using time and frequency domain techniques.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1508.1	3	1	1	0	3	0	0	0	0	0	0	0	3	3	0
EE1508.2	3	2	1	1	3	0	0	0	0	0	0	0	3	3	0
EE1508.3	3	2	1	1	3	0	0	0	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1508.1	3	1	1	0	3	0	0	0	0	0	0	3	3	0
EE1508.2	3	2	1	1	3	0	0	0	0	0	0	3	3	0
EE1508.3	3	2	1	1	3	0	0	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	SH1501 A								Course Category			OE
Course Name	ENVIRONMENTAL LAW											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basic concepts of environment, environmental studies, and the scope of environmental law.
2. To analyze how these principles are incorporated into Indian environmental legislation and upheld by the judiciary
3. To study the evolution of environmental protection from ancient, medieval, and modern India.
4. To analyze the role of the Indian Constitution in protecting the environment.
5. To critically analyze the role of the judiciary in interpreting and enforcing environmental laws.

Course Contents:

Introduction: Introduction to Environment and Environmental Law, Scope and Importance of Environmental Studies, Important Case Laws on Environmental Law.

Fundamental Principles of Environmental Law: Important Principles of Environmental Law, All about Public Trust Doctrine, incorporation of Precautionary Principle in Environmental Legislation, Application of Polluter Pays Principle In Indian Legal Jurisprudence, Role of Indian Judiciary in Upholding International Principles of Environmental Law, Sustainable Development.

History and Development of Environmental Law in India: History of Environment Protection Ancient, Medieval and Modern India, Efficacy of Environment Protection Act, 1986, Efficacy of Water Legislation in India,Efficacy of Air Legislation in India, Efficacy of Wildlife Protection Laws in India. Efficacy of Forest Legislation in India, Protection of Tribal Rights: An Effort through Environmental Legislation, A Critique on Criminal Law Provisions on Environment Protection.

Protection of Environment under the Indian Constitution: Protection of Environment under the Indian Constitution, Right to Clean and Healthy Environment under Indian Constitution: An Analysis.

Environment and the Judiciary: Section 133 CrPC: A Critical Analysis, Role of National Green Tribunal in Environment Protection, Role of Judiciary in Environment Protection, Role of Public Interest Litigation in Environmental Protection, Nature and Scope of Environmental Torts in India, The emergence of Noise Pollution Jurisprudence in India,Role of Judiciary in Preventing Noise Pollution, Role of Judiciary in Preventing Air Pollution.

Text Books:

1. Environmental Law by DrNishthaJaswal Dr. P S Jaswal
2. EBC Environmental Law S.C Shastri.
3. Introduction To Environmental Law by S. Shantakumar

Reference Books:

1. Lectures on Environmental Law by Rega Surya Rao
2. Environmental Laws Bare Act with Amendments
3. Universal's Environment Laws bare act (all acts)

Course Outcomes:

After successful completion of this course student will be able to:

SH1501A.1. Understand the basic Environmental law

SH1501A.2. Demonstrate a thorough understanding of the principles, laws, and policies governing Environmental protection in India.

SH1501A.3. Critically analyze the role of the judiciary, legislature, and other institutions upholding environmental laws.

SH1501A.4. Apply legal principles to contemporary environmental issues and propose solutions.

SH1501A.5. Develop a nuanced perspective on the intersection of environmental law with constitutional rights, tribal rights, and criminal law.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501A.1	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.2	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.3	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.4	0	0	0	0	0	2	2	2	2	0	2	0
SH1501A.5	0	0	0	0	0	2	2	2	2	0	2	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501A.1	0	0	0	0	0	2	2	2	0	2	1
SH1501A.2	0	0	0	0	0	2	2	2	0	2	1
SH1501A.3	0	0	0	0	0	2	2	2	0	2	1
SH1501A.4	0	0	0	0	0	2	2	2	0	2	1
SH1501A.5	0	0	0	0	0	2	2	2	0	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1501 B								Course Category			OE
Course Name	CYBER LAW											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the legal and regulatory frameworks governing cyberspace.
2. To familiarize students with key concepts such as cybercrime, data protection, intellectual property, and digital privacy.
3. To explore the ethical implications of technology and its impact on society.
4. To understand the role of national and international laws in addressing cyber threats and challenges.
5. To equip students with the knowledge to identify and mitigate legal risks in the development and deployment of technology.

Course Contents:

Introduction to Cyber Law

- Overview of Cyberspace and Cyber Law: Definition, scope, and importance.
- Evolution of Cyber Law: Historical development and global perspectives.
- Key Concepts: Jurisdiction, sovereignty, and challenges in cyberspace.
- Introduction to Cyber Ethics: Ethical issues in technology and digital behavior.

Cybercrime and Legal Frameworks

- Types of Cybercrimes: Hacking, phishing, identity theft, cyber terrorism, etc.
- Legal Frameworks for Cybercrime:
  Indian Context: Information Technology Act, 2000 (IT Act) and amendments.
  International Context: Budapest Convention on Cybercrime.
- Case Studies: Landmark cybercrime cases and their legal implications.
- Role of Law Enforcement Agencies: Cyber cells, CERT-In, and Interpol.

Data Protection and Privacy Laws

- Concept of Data Privacy: Importance and challenges.
- Data Protection Laws:
  Indian Context: Personal Data Protection Bill (PDPB), IT Act provisions.

Global Context: GDPR (General Data Protection Regulation), CCPA.
- Right to Privacy: Judicial interpretations and constitutional perspectives.
- Data Breaches and Legal Liabilities: Case studies and mitigation strategies.

Cybersecurity Laws and Regulations:
- Importance of Cybersecurity: Threats, vulnerabilities, and risk management.
- Legal Frameworks for Cybersecurity:
  Indian Context: National Cybersecurity Policy, IT Act provisions.
  Global Context: NIST Framework, EU Cybersecurity Act.
- Role of Organizations: CERT-In, NCIIPC, and international cybersecurity agencies.
- Compliance and Best Practices: Implementing cybersecurity measures in organizations.

Text Books:
1. "Cyber Law in India" by S. S. Jaswal.
2. "Information Technology Law and Practice" by Vakul Sharma.
3. "Cyber Law and Cyber Crimes" by Nandan Kamath.

Reference Books:
1. Information Technology Act, 2000 (India).
2. General Data Protection Regulation (GDPR).
3. "Cybersecurity and Cyber Law" by Nina Godbole.
4. "The Law of Cybercrimes and Their Investigations" by George Curtis.

Course Outcomes:

After successful completion of this course student will be able to:

SH1501B.1 Understand the legal and ethical dimensions of cyberspace.

SH1501B.2 Identify and analyze cybercrimes and their legal consequences.

SH1501B.3 Apply cyber law principles to real-world scenarios in technology development and usage.

SH1501B.4 Evaluate the impact of cyber security laws on businesses and individuals.

SH1501B.5 Develop strategies to comply with data protection and privacy regulations.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501B.1	2	2	2	2	2	2	0	2	2	2	1	1
SH1501B.2	2	2	2	2	2	2	0	2	2	2	1	0
SH1501B.3	2	2	2	2	2	2	0	2	2	2	1	2
SH1501B.4	2	2	2	2	2	2	0	2	2	2	1	2
SH1501B.5	2	2	2	2	2	2	0	2	2	2	1	2

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CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501B.1	2	2	2	2	2	2	2	2	2	2	1
SH1501B.2	2	2	2	2	2	2	2	2	2	2	1
SH1501B.3	2	2	2	2	2	2	2	2	2	2	1
SH1501B.4	2	2	2	2	2	2	2	2	2	2	1
SH1501B.5	2	2	2	2	2	2	2	2	2	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	SH1501 C								Course Category			OE
Course Name	INTRODUCTION TO MASS COMMUNICATION											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basic concepts, theories, and models of mass communication.
2. To explore the role of mass media in shaping public opinion, culture, and society.
3. To familiarize students with the various forms of mass media (print, electronic, digital, and social media).
4. To examine the ethical and legal issues in mass communication.
5. To develop critical thinking and analytical skills in evaluating media content and provide hands-on experience in creating basic media content.

Course Contents:

Introduction to Mass Communication

- Definition and Scope: What is mass communication?
- Elements of Mass Communication: Sender, message, channel, receiver, feedback, and noise.
- Functions of Mass Media: Information, education, entertainment, and persuasion.
- Theories of Mass Communication: Hypodermic Needle Theory, Two-Step Flow Theory, Agenda-Setting Theory, and Uses and Gratifications Theory.

Forms of Mass Media

- Print Media: Newspapers, magazines, and books.
- Electronic Media: Radio, television, and cinema.
- Digital Media: Internet, websites, and blogs.
- Social Media: Platforms, trends, and impact.
- Comparative Analysis: Strengths and limitations of each medium.

Role of Mass Media in Society

- Media and Public Opinion: Shaping perceptions and attitudes.
- Media and Culture: Influence on language, traditions, and values.
- Media and Democracy: Role in elections, governance, and accountability.
- Media and Globalization: Cross-cultural communication and global trends.

Media Ethics and Laws

- Ethical Issues in Mass Communication: Bias, sensationalism, and privacy concerns.
- Media Laws and Regulations: Freedom of speech, censorship, and regulatory bodies.
- Case Studies: Ethical dilemmas and legal controversies in media.

Technology and Mass Communication

- Impact of Technology on Media: Digital transformation and convergence.
- Emerging Trends: Artificial Intelligence, Virtual Reality, and Augmented Reality in media.
- Social Media Algorithms: How they shape content consumption.
- Fake News and Misinformation: Challenges and solutions.

Text Books:

1. "Mass Communication in India" by Keval J. Kumar.
2. "Introduction to Mass Communication" by Stanley J. Baran.
3. "Media and Communication Studies: An Introduction" by James Watson and Anne Hill.

Reference Books:

1. "Understanding Media: The Extensions of Man" by Marshall McLuhan.
2. "Media and Society: Power, Platforms, and Participation" by Nicholas Carah.
3. "The Elements of Journalism" by Bill Kovach and Tom Rosenstiel.

Course Outcomes:

After successful completion of this course student will be able to:

SH1501C.1 Understand the fundamentals of mass communication and its role in society.
SH1501C.2 Analyze the impact of mass media on individuals, communities, and cultures.
SH1501C.3 Identify the strengths and limitations of different forms of mass media.
SH1501C.4 Critically evaluate media content for bias, accuracy, and ethical considerations.
SH1501C.5 Create basic media content using simple tools and techniques and appreciate th intersection of technology and mass communication.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501C.1	1	0	0	1	1	0	0	0	1	0	0	1
SH1501C.2	0	1	1	0	2	0	0	0	1	0	0	1
SH1501C.3	1	1	1	0	1	0	0	0	0	0	0	1
SH1501C.4	1	0	1	1	0	0	0	0	1	0	0	1
SH1501C.5	1	0	1	1	3	0	0	0	1	0	0	1

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501C.1	1	0	0	1	0	0	0	0	1	0	1
SH1501C.2	0	1	1	0	0	0	0	0	2	0	1
SH1501C.3	1	1	1	0	0	0	0	0	1	0	1
SH1501C.4	1	0	1	1	0	0	0	0	0	0	1
SH1501C.5	1	0	1	1	0	0	0	0	3	0	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	SH1501 D							Course Category			OE
Course Name	BASIC GERMAN LANGUAGE A1										
Teaching Scheme				Examination Scheme							Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
03	-	-	03	15	15	10	60	2 hrs. 30 min	-	-	100	3

Course Objectives:

To make the student aware and understand:

1. To introduce students to the basics of the German language, including pronunciation, grammar, and vocabulary.
2. To develop basic communication skills in German for everyday situations.
3. To familiarize students with German culture, traditions, and etiquette.
4. To prepare students for further language learning and potential opportunities in German-speaking countries.
5. To enhance students' global competence and intercultural communication skills.

Course Contents:

Introduction to German Language and Culture

- Alphabet and Pronunciation: German alphabet, sounds, and basic pronunciation rules.
- Greetings and Introductions: Common greetings, introducing oneself, and basic polite expressions.
- Numbers and Dates: Counting, telling time, and discussing dates.
- Cultural Insights: Overview of German-speaking countries, traditions, and etiquette.

Basic Grammar and Sentence Structure

- Articles and Gender: Definite and indefinite articles (der, die, das).
- Nouns and Plurals: Basic noun forms and pluralization rules.
- Pronouns: Personal pronouns (ich, du, er/sie/es, etc.).
- Basic Sentence Structure: Subject-verb-object order and forming simple sentences.

Everyday Communication

- Asking for Directions: Common phrases for navigating and understanding directions.
- Shopping and Ordering: Vocabulary for shopping, ordering food, and making payments.
- Daily Activities: Talking about daily routines, hobbies, and free time.
- Role-Playing: Simulating real-life situations (e.g., at a café, market, or train station).

Vocabulary Building

- Family and Friends: Vocabulary for describing family members and relationships.
- Food and Drink: Common food items, meals, and dining vocabulary.
- Travel and Transportation: Vocabulary for travel, public transport, and booking tickets.
- Practice Sessions: Interactive activities to reinforce vocabulary

Reading and Writing in German

- Reading Simple Texts: Short dialogues, signs, and advertisements.
- Writing Practice: Filling out forms, writing short messages, and emails.
- Listening Comprehension: Understanding slow and clear spoken German.
- Speaking Practice: Participating in simple conversations and role-plays.

Cultural Immersion and Practical Applications

- German Culture: Festivals, traditions, and cultural norms.
- Engineering and Technology in Germany: Overview of Germany's role in engineering and innovation.
- Opportunities in German-Speaking Countries: Study, work, and internship opportunities.
- Final Project: Presenting a short dialogue or skit in German.

Text Books:

1. "Netzwerk A1" by Stefanie Dengler et al.
2. "Menschen A1" by Sandra Evans et al.
3. "Schritte International A1" by Daniela Niebisch et al.

Reference Books:

1. "German for Dummies" by Paulina Christensen et al.
2. "Practice Makes Perfect: Basic German" by Jolene Wochenske.
3. "Langenscheidt German-English Dictionary".

Course Outcomes:

After successful completion of this course student will be able to:

SH1501D.1 Understand and use familiar everyday expressions and basic phrases.
SH1501D.2 Introduce themselves and others, and ask and answer questions about personal details.
SH1501D.3 Interact in a simple way, provided the other person speaks slowly and clearly.
SH1501D.4 Read and write simple texts in German.
SH1501D.5 Appreciate German culture and its relevance in a global context.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1501D.1	1	0	0	0	0	0	1	0	3	0	0	0
SH1501D.2	0	1	1	0	0	0	1	0	3	0	0	0
SH1501D.3	1	1	1	0	0	0	1	0	3	0	0	0
SH1501D.4	1	0	1	0	0	0	1	0	0	0	0	0
SH1501D.5	1	0	1	0	0	0	1	0	3	0	0	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1501D.1	1	0	0	1	0	0	0	0	0	0	0
SH1501D.2	0	1	1	0	0	0	0	0	0	0	0
SH1501D.3	1	1	1	0	0	0	0	0	0	0	0
SH1501D.4	1	0	1	1	0	0	0	0	0	0	0
SH1501D.5	1	0	1	1	0	0	0	0	0	0	0

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated

3- Strongly Correlated

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Course Code	SH1503								Course Category			MNC2
Course Name	SOFT SKILLS											
Teaching Scheme				Examination Scheme								Credits
				Theory					Practical		Total	
Th	Tu	Pr	Total	CT-1	CT-2	TA	ESE	ESE Duration	ICA	ESE		
02	-	-	02	-	-	20	-	-	-	-	20	2

Course Objectives:

To make the student aware and understand:

3. Develop essential soft skills for academic, professional, and personal growth.
4. Enhance communication, teamwork, leadership, and emotional intelligence.
3. Provide hands-on training through interactive activities and real-world scenarios.
4. Improve employability and workplace readiness.

Course Contents:

Introduction to Soft Skills:

- Definition and importance of soft skills
- Difference between hard skills and soft skills
- Self-assessment: Identifying strengths and areas for improvement

Effective Communication:

- Verbal & Non-verbal communication
- Active listening & feedback techniques
- Public speaking & presentation skills
- Business email etiquette

Interpersonal & Teamwork Skills:

- Building rapport & networking
- Conflict resolution & negotiation
- Collaboration & team dynamics

Emotional Intelligence:

- Self-awareness & self-regulation
- Empathy & social skills
- Stress management & resilience

Leadership & Professional Ethics:

- Traits of effective leaders
- Decision-making & problem-solving

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- Workplace ethics & professionalism

Time Management & Adaptability:

- Prioritization & goal setting
- Handling multitasking & deadlines
- Adapting to change & workplace challenges

Career Readiness:

- Resume writing & interview skills
- Personal branding (LinkedIn, networking)
- Workplace etiquette & corporate culture

Text Books:

4. Text Book of Soft Skills (Paperback, Paul Martin, Kavita Krishnamurthi)
5. How to Win Friends & Influence People (Dale Carnegie), Emotional Intelligence 2.0 (Travis Bradberry)
6. Soft Skills Unleashed By Krishna Suresh

Reference Books:

1. "Personality Development and Soft Skills (Old Edition)" by Barun K Mitra
2. "Soft Skills - Enhancing Employability: Connecting Campus with Corporate" by M S Rao
3. "communication and soft skill development (first edition)" by career publications and Ashwini Deshpande
4. "Soft Skills Training: A Workbook to Develop Skills for Employment" by Frederick H Wentz

Course Outcomes:

After successful completion of this course student will be able to:

SH1503.1. Understand the importance of soft skill.
SH1503.2. Communicate confidently in professional settings.
SH1503.3. Work effectively in teams with strong interpersonal skills.
SH1503.4. Demonstrate leadership and problem-solving abilities.
SH1503.5. Be better prepared for job interviews and workplace challenges.

CO – PO – PSO mapping as per NBA Jan 2016 format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
SH1503.1	0	1	0	0	0	1	2	2	2	0	2	0
SH15032	0	0	0	0	0	1	2	2	2	0	2	0
SH1503.3	0	1	0	0	0	1	2	2	2	0	2	0
SH1503.4	0	0	0	0	0	1	2	2	2	0	2	0
SH1503.5	0	1	0	0	0	1	2	2	2	0	2	0

CO – PO – PSO mapping as per NBA July 2024 format (w.e.f. 1 Jan. 2025):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
SH1503.1	0	0	1	0	0	2	0	2	0	2	1
SH15032	0	0	1	0	0	2	0	2	0	2	1
SH1503.3	0	0	1	0	0	2	0	2	0	2	1
SH1503.4	0	0	1	0	0	2	0	2	0	2	1
SH1503.5	0	0	1	0	0	2	0	2	0	2	1

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Course Code	EE1521	Course Category	PEH
Course Name	DIGITAL SIGNAL PROCESSING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	--	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Concept of digital signal processing.
2. Working and analysis DSP systems.
3. Design and implementation of digital filters.

Course Contents:

Introduction to Digital Signal Processing: Introduction to Digital Signal Processing: Discrete-Time Signals & Sequences, Linear Shift Invariant Systems, Stability, and Causality, Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete-Time Signals and systems.

Discrete Fourier Transforms: Properties of DFT. Linear Convolution of Sequences using DFT. Computation of DFT: Over-lap Add Method, Over-lap Save Method, Relation between DTFT, DFS, DFT and Z-Transform. Fast Fourier Transforms Fast Fourier Transforms (FFT) – Radix-2 Decimation-in-Time and Decimation-in- Frequency FFT Algorithms, Inverse FFT and FFT with General Radix-N.

IIR Digital Filters: Specifications and characteristic of ideal filters, Synthesis of Discrete Time Filters, Realizable specifications, Analog Filter Approximations – Butterworth and Chebyshev, Design of IIR Digital filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method. IIR Filter Realization, Cascade Structure, Lattice Structure

FIR Digital Filters: Characteristics of FIR Digital Filters, Frequency Response. Design of FIR Filters using Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Realization of FIR Function, Comparison of IIR & FIR filters. Finite word length effects.

Multirate Digital Signal Processing: Introduction, Downsampling, Decimation, Upsampling, Interpolation, Sampling Rate Conversion, Applications of Multi-Rate Signal Processing.

Text Books:

1. Sanjit K. Mishra, "Digital Signal Processing: A Computer-based Approach", Tata McGraw Hill
2. P. Oppenheim, Alan V., Ronald W. Schafer, and John R. Buck, "Discrete-time signal processing", 2nd edition TMH publication, 1998

Reference Books:

1. Proakis, John G., "Digital signal processing: principles algorithms and applications", Pearson Education India.
2. Hayes, Monson H., "Digital signal processing", Tata McGraw-Hill, Edition 2004.

Course Outcomes:

After completion of the course, the students will be able to:

EE1521.1 Interpret and represent discrete/digital signals and systems.
EE1521.2 Apply techniques in time and transform domains to the analysis and design of discrete-time systems
EE1521.3 Design IIR filters and apply them to real-world applications.
EE1521.4 Design FIR filters and apply them to real-world applications.
EE1521.5 Understand multirate digital signal processing.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1521.1	2	2	1	1	0	0	0	0	0	0	0	0	3	0	0
EE1521.2	2	2	2	1	0	0	0	0	0	0	0	0	3	0	0
EE1521.3	2	3	3	2	0	0	0	0	0	0	0	0	3	0	0
EE1521.4	2	3	3	2	0	0	0	0	0	0	0	0	3	0	0
EE1521.5	1	2	2	1	0	0	0	0	0	0	0	0	3	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1521.1	2	2	1	1	0	0	0	0	0	0	0	3	0	0
EE1521.2	2	2	2	1	0	0	0	0	0	0	0	3	0	0
EE1521.3	2	3	3	2	0	0	0	0	0	0	0	3	0	0
EE1521.4	2	3	3	2	0	0	0	0	0	0	0	3	0	0
EE1521.5	1	2	2	1	0	0	0	0	0	0	0	3	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1522							Course Category		PEH
Course Name	OPERATION AND PLANNING OF POWER DISTRIBUTION SYSTEMS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	--	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Different components and layouts of power distribution systems and load models
2. Various reliability assessment techniques and planning approaches
3. Impact of distributed generation on distribution systems

Course Contents:

Introduction, overview and Load modelling:

Power systems: Overview and historical developments, Introduction to power delivery systems, Introduction to electrical loads. Load diversity, Different load indices, Loss factor, Load Management.

Basic features of distribution systems:

Brief overview of power distribution substation, Substation bus schemes and primary distribution network topology. Voltage drop and power loss computations for typical radial distribution feeders, Generalized expression for voltage drop for radial distribution feeder, Derivation of K-constant for voltage drop computation.

Reliability and Power quality assessment of distribution systems:

Different reliability indices used in distribution networks, Different reliability indices with numerical examples, Mathematical concept of reliability. Reliability evaluation of multiple units connected in series and/or parallel, Numerical problems on reliability evaluation, Power quality problems in distribution systems.

Distribution system load flow approach and Reactive power compensation in distribution systems:

Forward backward load flow approach for power distribution systems. Reactive power compensation: Basic idea, Numerical examples, Capacitor placement at distribution feeder: Analytical approach.

Power Distribution system planning and reconfiguration, and Active distribution networks with the integration of Distributed Generation (DG):

Economic aspects, Different models and solution strategies, Mono-objective and multi-objective power distribution system planning approach, Multi-objective planning incorporating sectionalizing switches and tie-lines. Reconfiguration of power distribution networks. Active distribution networks with the integration of Distributed Generation, Concept of microgrids, Wind and solar energy conversion systems, Energy storage systems. Distribution system automation and smart grid.

Text Books:

1. T. Gonen. Electric Power Distribution System Engineering; CRC Press, 3rd Edition, 2014.
2. H. Lee. Willis. Power Distribution Planning Reference Book; CRC press, 2nd Edition, Revised and Expanded, 2004.

Reference Books:

1. A. S. Pabla, Electric Power Distribution; Tata Mcgraw-Hill Publishing Company Ltd., 5th Edition, 2007.
2. Math Bollen and Fainan Hassan, Integration of Distributed Generation in the Power System; IEEE Press, 2011.
3. R. Billington and R. Allan, Reliability Evaluation of Power Systems; Springer, Berlin, 2nd Edition, 1996.

Course Outcomes:

After completion of the course, the students will be able to:

EE1522.1	Discuss an overview of modern power distribution systems and load modelling.
EE1522.2	Brief about the power distribution substation, voltage drop and power loss computations for typical radial distribution feeders.
EE1522.3	Evaluate the reliability and power quality assessment techniques of distribution systems.
EE1522.4	Analyse the load flow approach and reactive power compensation techniques in distribution systems.
EE1522.5	Demonstrate the evolution of distribution systems toward smart network and impact of distributed generation on distribution systems.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1522.1	1	2	1	0	0	0	0	0	0	0	0	0	1	0	1
EE1522.2	1	2	1	0	0	0	0	0	0	0	0	0	1	0	1
EE1522.3	2	3	2	1	0	0	0	0	0	0	0	0	1	0	1
EE1522.4	2	3	2	1	0	0	0	0	0	0	0	0	2	0	1
EE1522.5	3	3	3	2	2	0	0	0	0	0	0	0	3	0	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1522.1	1	2	1	0	0	0	0	0	0	0	0	1	0	1
EE1522.2	1	2	1	0	0	0	0	0	0	0	0	1	0	1
EE1522.3	2	3	2	1	0	0	0	0	0	0	0	1	0	1
EE1522.4	2	3	2	1	0	0	0	0	0	0	0	2	0	1
EE1522.5	3	3	3	2	2	0	0	0	0	0	0	3	0	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1531	Course Category	PER
Course Name	RESEARCH PROJECT STAGE - I		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	08	08	--	--	--	--	--	100	--	100	04

Course Objectives:

To make the students aware and understand:

1. Gain domain specific knowledge by completing the specific course
2. Collecting information on novel and latest development in the specific area of the Electrical Engineering.
3. Formulating specific problem statement and design a suitable solution methodology for the problem

Course Contents:

At the beginning of V-semester, just before the commencement of classes, eligible students can register for the B. Tech. with Honours in Research. The research topic/area selected should have relevance to social needs of society and needs of the industry.

Registered Student will have to discuss with his/her respective guide about the specific area for carrying out the research work. He/she will have to complete the theory courses through online platform such as MOOCs, NPTEL etc. as prescribed by the guide/supervisor. Student will have to

(i) Formulate the specific problem statement,
(ii) Carry out the research literature survey for acquiring in depth knowledge in the chosen domain.
(ii) Design a suitable solution methodology for the problem,
(iv) Share the details of literature survey, hypothesis, etc. with the guide.

Student will be required to deliver the seminar on the literature survey and proposed research topic at the end of V-semester.

Internal Continuous Assessment (ICA): Student will be required to deliver a seminar based on the work carried out. The ICA includes the assessment on the basis of seminar to be evaluated by the three-member committee constituted by the Head of Department.

Course Outcomes:

After completion of the course, the students will be able to:

EE1531.1 Plan an investigative research problem

EE1531.2 Apply the in-depth knowledge gained in the domain area such as existing methods and their limitations, etc. through literature survey and course attended.

EE1531.3 Formulate suitable solution methodology for the research problem

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1531.1	2	3	3	0	0	0	0	0	0	0	2	0	0	2	0
EE1531.2	2	0	0	2	3	0	0	0	3	0	0	2	0	0	0
EE1531.3	3	0	3	3	0	2	2	0	0	0	0	0	0	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 – Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1531.1	2	3	3	0	0	0	0	0	0	2	0	3	2	0
EE1531.2	2	0	0	2	3	0	0	3	0	0	2	0	0	0
EE1531.3	3	0	3	3	0	2	0	0	0	0	0	2	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1541							Course Category		MN
Course Name	NETWORK ANALYSIS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2 hrs. 30 min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Analyze electrical circuit networks.
2. Determine steady state behaviour of the electrical networks.
3. Evaluate the electrical circuits using Laplace Transform and estimate the parameters of two port networks.

Course Contents:

Network Theorems

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem. Analysis with dependent current and voltage sources, Nodal and Mesh Analysis, Concept of duality and dual networks.

Sinusoidal Steady State Analysis of Single-Phase Circuits

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power.

Steady State Analysis of Three-Phase Circuits and Coupled Circuits

Three-phase circuits, Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Electrical Circuit Analysis using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros.

Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters.

Text Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
3. D. Roy Choudhury "Networks and Systems", New Age International Publications, 1998.

References Books:

1. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
2. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.
3. Sudhakar Shyammohan, "Circuit and Network Analysis", Tata McGraw Hill 2005

Course Outcomes:

After completion of the course, the students will be able to:

EE1541.1 Apply network theorems for the analysis of electrical circuits.
EE1541.2 Obtain the steady-state response of single-phase electrical circuits.
EE1541.3 Analyze the circuits in the sinusoidal steady-state (three-phase and coupled circuits).
EE1541.4 Evaluate the circuits using Laplace transform.
EE1541.5 Analyze two port networks.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1541.1	2	0	0	0	1	1	1	0	0	0	0	0	1	0	0
EE1541.2	2	0	0	0	1	1	1	0	0	0	0	0	1	0	0
EE1541.3	2	0	0	0	1	1	1	0	0	0	0	0	1	0	0
EE1541.4	2	0	0	0	1	1	1	0	0	0	0	0	1	0	0
EE1541.5	2	0	0	0	0	1	2	0	0	0	0	0	1	0	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1541.1	2	0	0	0	1	1	1	0	0	0	0	1	0	0
EE1541.2	2	0	0	0	1	1	1	0	0	0	0	1	0	0
EE1541.3	2	0	0	0	1	1	1	0	0	0	0	1	0	0
EE1541.4	2	0	0	0	1	1	1	0	0	0	0	1	0	0
EE1541.5	2	0	0	0	0	1	2	0	0	0	0	1	0	0

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Course Code	EE1542	Course Category	MN
Course Name	ELECTRICAL MACHINES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Basic concept of AC/DC machines.
2. Operation of AC/DC machines.
3. Applications of electrical machines.

Course Contents:

DC Machines

Basic construction of a DC machine, working principle as Generator and Motor, Derivation of emf equation and torque equation, back emf, classification, characteristics of generator and motor, speed control of dc motor, applications. **(Theorotical concepts only)**

Transformers

Principle, construction and operation of single-phase transformers, phasor diagram, voltage regulation, losses and efficiency, open circuit and short circuit tests. **(Including Numerical)**
Three-phase transformers construction, various connections, Autotransformer applications **(Theoretical concepts only)**

Synchronous Machines

Alternator: Working Principle and Construction of Alternator, Armature Windings, Distribution Factor and Pitch Factor, Equation of Induced E.M.F. Alternator on Load, Synchronous Reactance Vector Diagrams of Loaded Alternator, Voltage Regulation, Direct Loading Method **(Theorotical concepts only)**

Synchronous Motor: General Principle of Operation Method of Starting, Motor on Load with Constant Excitation, Power Flow, Operation with Different Excitations, Effect of changing Excitation and changing load, Applications **(Theoretical concepts only)**

Induction Machines

Concept of rotating magnetic field, Construction and working principle, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Losses and Efficiency. Constructional features, classification and applications of single-phase Induction motor.

Text Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
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 & Sons

References Books:

1. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers,2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.

Course Outcomes:

After completion of the course, the students will be able to:

EE1542.1 Understand the operation of dc machines
EE1542.2 Evaluate the differences in operation of different dc machine configurations.
EE1542.3 Investigate and analyse the performance of synchronous machines.
EE1542.4 Understand single phase and three phase transformers circuits and connections
EE1542.5 Investigate and analyse the performance of Induction machines.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1542.1	1	1	0	2	0	0	0	0	0	0	0	0	2	2	0
EE1542.2	2	1	1	1	0	0	0	0	0	0	0	0	1	0	1
EE1542.3	1	2	1	1	0	0	0	0	0	0	0	0	2	2	0
EE1542.4	2	1	1	0	0	0	1	0	0	0	0	0	2	0	1
EE1542.5	1	1	1	0	0	0	0	0	0	0	0	0	2	0	2

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1542.1	2	2	0	2	1	0	0	0	0	0	0	2	2	0
EE1542.2	2	1	1	2	0	0	0	0	0	0	0	1	0	2
EE1542.3	2	2	1	2	0	0	0	0	0	0	0	2	2	0
EE1542.4	2	2	1	0	1	0	1	0	0	0	0	3	0	0
EE1542.5	1	1	1	0	0	0	0	0	0	0	1	2	0	2

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SEMESTER – VI

Course Code	EE1601	Course Category	PC
Course Name	ELECTRICAL POWER - II		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

At the end of this course, students will be able to:

1. Analyze different faults in power system
2. Explain stability constraints in a synchronous grid.
3. Understand methods to control the voltage, frequency and power flow.

Fault Analysis: Symmetrical Fault Analysis, Three Phase Power in Unbalanced Circuit In Terms Of Symmetrical Component, Symmetrical Component Transformation, Sequence Impedances of Generator Transformer Transmission Line & Passive Loads Phase Shift In Y/Delta Three Phase Transformer (Yd1, Yd11 Connection). Unsymmetrical Fault Analysis: L-G, L-L-G-, L-L-L, LL-L-G, Open Conductors Fault Using Symmetrical Components, Selection of Circuit Breakers Ratings, Current Limiting Reactors , Numericals based on fault analysis.

Power System Stability: Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability - simple treatment of angle stability into small-signal and large-signal (transient) stability Single Machine Infinite Bus (SMIB) system

Transient Stability: Development of swing equation - equal area criterion - determination of critical clearing angle and time by using modified Euler method and Runge-Kutta second order method. Algorithm and flow chart.

Economic Operation of Power System: Introduction, Distribution of Load between Units within the Plant. Optimum Generation Scheduling, Considering, Transmission Losses Representation of Transmission Loss, Using Loss Formula Co-Efficient, Derivation of Loss Formula Co-Efficient Simulation of Co-Ordination Equation on Digital Computer

Energy control centre: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: Normal, alert,

emergency, extremis and restorative. State transition diagram showing various state transitions and control strategies.

Course Outcomes:

After completion of the course, the students will be able to:

EE1601.1 Analyze the symmetrical and unsymmetrical faults.

EE1601.2 Compute and analyze transient stability of given power System

EE1601.3 Solve power system problems for frequency and voltage control.

EE1601.4 Comprehend the basics of economic power system.

EE1601.5 Understand the monitoring and control of a power system

Text Books:

1. O. I. Elgerd, Electric Energy Systems Theory, McGraw-Hill publications, 1971
2. John J. Grainger, W. D. Stevenson, Power System Analysis, McGraw-Hill (India) Pub., 2003

Reference Books:

1. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
2. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
3. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1601.1	2	2	2	1	0	0	0	0	0	0	0	0	1	1	0
EE1601.2	3	3	3	2	2	0	0	0	0	0	0	0	1	2	0
EE1601.3	3	3	3	2	2	0	0	0	0	0	0	0	0	3	0
EE1601.4	1	1	1	2	2	0	0	0	0	0	0	2	2	2	0
EE1601.5	1	1	1	3	2	0	0	0	0	0	0	1	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1601.1	2	2	2	1	0	0	0	0	0	0	0	1	1	0
EE1601.2	3	3	3	2	2	0	0	0	0	0	0	1	2	0
EE1601.3	3	3	3	2	2	0	0	0	0	0	0	0	3	0
EE1601.4	1	1	1	2	2	0	0	0	0	0	2	2	2	0
EE1601.5	1	1	1	3	2	0	0	0	0	0	1	0	1	0

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Course Code	EE1602	Course Category	PC
Course Name	CONTROL SYSTEM DESIGN		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make students aware and understand:

1. Understand various design specifications.
2. Design controllers such as P, PI, PID, compensators to satisfy the desired design specifications
3. Design controllers using the state-space approach

Design Specifications

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Design of Classical Control System in the time domain

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using Bode diagram.

Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Control System Design in state space

Review of state space representation and Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of observer. Reduced order observer. Separation Principle.

Sampled Data Control Systems
Representation, Z Transforms. review, Sampler and Hold - zero order hold; Sampling theorem; Z Transform analysis – open loop and closed loop sampled data systems, Z Transfer functions, Difference equation solution and response; Z Transform Method,. Discrete Systems Response, Open and closed loop systems pulse transfer functions - Different sampler locations; Digital Controller - transfer function; Stability analysis - S and Z Domain relationship, Jury's Test and Bi-Linear Transformation.

Non-Linear System Analysis
Non-linear system behaviour – types and characteristics; Describing functions - typical non-linearity and their characteristics; Stability analysis - Describing function method and Limit cycles; Limitations - describing function method.

Linearization - Around operating point; Singular points – Classification and Nature; Phase-plane method - non- linear systems analysis; Phase trajectories construction – analytical method and graphical method by isocline method; Stability analysis - limit cycle; Limitations - phase-plane method.

Text Books:

1. N. Nise, "Control System Engineering", John Wiley, 2019.
2. I. J. Nagrath and M. Gopal, "Control System Engineering", Wiley, 2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.

Reference Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 2010.
2. B. C. Kuo, "Automatic Control system", Prentice Hall, 1995.
3. J. J. D'Azzo and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
4. R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994

Course Outcomes:

After completion of the course, the students will be able to:

EE1602.1	Understand the design specifications and Design different compensators for linear-time invariant systems in time and frequency domain.
EE1602.2	Design of P, PI, PD and PID controllers in time domain and frequency domain
EE1602.3	Undertake control system design in state space
EE1602.4	Analyse sampled data control system
EE1602.5	Analyse different types of non-linearities in the system by describing function and phase plane analysis

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1602.1	3	2	0	1	0	0	0	0	0	0	0	0	2	3	0
EE1602.2	3	3	0	2	3	0	0	0	0	0	0	0	1	3	0
EE1602.3	3	3	0	3	2	0	0	0	0	0	0	0	0	3	0
EE1602.4	3	3	3	2	3	0	0	0	0	0	0	0	1	3	0
EE1602.5	3	3	0	3	2	0	0	0	0	0	0	0	0	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1602.1	3	2	0	1	0	0	0	0	0	0	0	2	3	0
EE1602.2	3	3	0	2	3	0	0	0	0	0	0	1	3	0
EE1602.3	3	3	0	3	2	0	0	0	0	0	0	0	3	0
EE1602.4	3	3	3	2	3	0	0	0	0	0	0	1	3	0
EE1602.5	3	3	0	3	2	0	0	0	0	0	0	0	3	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1603A	Course Category	PE
Course Name	POWER SYSTEM PROTECTION		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
04	-	-	04	15	15	10	60	2 hrs. 30 min.	-	-	100	04

Course Objectives:

To make students aware and understand:

1. Various protection schemes for different power system components.
2. The importance of Digital relays.
3. Develop various protection schemes.

Introduction and Components of a Protection System: Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Faults and Over-Current Protection: Review of Fault Analysis, Sequence Networks. Introduction to Over current Protection and over current relay co-ordination.

Equipment Protection Schemes: Directional, Distance, Differential protection, Transformer and Generator protection. Bus bar Protection and Bus Bar arrangement schemes, Protection of Induction Motors against Overload and Short Circuits.

System Protection: Effect of Power Swings on Distance Relaying System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection.

Introduction to Numerical Relays: Basic Principles, Sampling Theorem, Filtering, Anti-aliasing Filters, Introduction to algorithms, Synchrophasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS).

Text Books:

1. J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, New York, 1987.
2. Y. G. Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India, 2010.

Reference Books:

1. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
2. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
3. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

Course Outcomes:

After completion of the course, the students will be able to:

EE1603A.1 Understand the different components of a protection system.
EE1603A.2 Evaluate fault current due to different types of fault in a network.
EE1603A.3 Understand the protection schemes for different power system components.
EE1603A.4 Understand the basic principles of digital protection.
EE1603A.5 Understand system protection schemes, and the use of wide-area measurements.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1603A.1	2	2	0	1	0	0	0	0	0	0	0	0	1	1	0
EE1603A.2	3	1	0	2	2	0	0	0	0	0	0	0	1	2	0
EE1603A.3	3	1	0	2	2	0	0	0	0	0	0	0	0	3	0
EE1603A.4	1	3	3	2	2	0	0	0	0	0	0	0	2	2	0
EE1603A.5	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1603A.1	2	2	0	1	0	0	0	0	0	0	0	1	1	0
EE1603A.2	3	1	0	2	2	0	0	0	0	0	0	1	2	0
EE1603A.3	3	1	0	2	2	0	0	0	0	0	0	0	3	0
EE1603A.4	1	3	3	2	2	0	0	0	0	0	0	2	2	0
EE1603A.5	1	1	0	0	0	0	0	0	0	0	0	0	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1603B	Course category	PE
Course Name	ENERGY RESOURCES, ENVIRONMENT AND ECONOMICS		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2hrs. 30min.	--	--	100	04

Course Objectives:

To make the students aware and understand:

1. The concept of different energy sources.
2. Present Indian energy scenario and energy policies.
3. Energy efficiency, energy economics, and future energy sources.

Course Contents:

Basics of energy and its various forms: Overview of Indian energy scenario, various forms of energy, major primary and secondary energy sources, other primary energy sources available, commercial and non-commercial energy sources, renewable and non-renewable energy sources, global primary energy reserves, strategies for better energy security of nation, introduction to energy conservation and its importance, energy sector reforms, energy policy, energy regulation, energy forecasting, energy efficiency.

Energy and Environment: Air pollution, So_x, No_x, Co, CFC, water pollution, acid rain, green-house effect, carbon cycle, environmental consequences of fossil fuel use.

Global environmental concerns: Ozone layer depletion, its effects, global warming, implications of global warming (climate change), Co_2 emissions, impacts, mitigation, sustainability, clean development mechanism (CDM), prototype carbon fund (PCF).

Energy Economics: Cost factors, budgeting, standard costing, sources of capital, cash flow diagram, activity chart, simple payback period analysis, time value of money, net present value method, internal rate of return method, profitability index for benefit cost ratio. Simple illustrative numerical.

Future Energy Systems: Introduction to hydrogen, properties of hydrogen, sources of hydrogen, production of hydrogen, storage of hydrogen, Introduction to fuel cell.

Text Books:

1. Fowler, J. M., Energy and Environment, McGraw Hill, New York 1984.
2. Energy Management: W. R. Murphy, G. Mckay, Butteworths Heinemann. An imprint of Elsevier.
3. Guide book for National certification examination for energy managers and energy auditors. Bureau of energy efficiency.
4. Non-conventional energy sources: G. D. Rai, Khanna Publishers, Darya Gani, New Delhi.

Course Outcomes:

After completion of the course, the students will be able to:

EE1603B.1 Understand different sources of energy
EE1603B.2 Know energy pricing/marketing
EE1603B.3 Analyse the role of energy in the economy
EE1603B.4 Interpret energy economics and how to maintaining a balance between economic development and environmental quality
EE1603B.5 Understand the importance of future energy sources.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1603B.1	2	0	0	0	0	2	3	1	0	0	0	0	2	0	0
EE1603B.2	2	2	1	2	2	2	2	1	0	2	3	0	2	0	1
EE1603B.3	2	2	1	2	2	2	2	1	0	2	3	0	2	0	1
EE1603B.4	2	2	1	2	2	2	3	1	0	2	3	0	2	0	1
EE1603B.5	2	0	0	2	2	2	2	1	0	2	3	2	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1603B.1	2	-	-	-	-	2	3	1	-	--	-	2	-	-
EE1603B.2	2	2	1	2	2	2	2	1	-	2	3	2	-	1
EE1603B.3	2	2	1	2	2	2	2	1	-	2	3	2	-	1
EE1603B.4	2	2	1	2	2	2	3	1	-	2	3	2	-	1
EE1603B.5	2	-	-	2	2	2	2	1	-	2	2	2	-	-

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Course Code	EE1603C	Course Category	PE
Course Name	EV BATTERIES AND CHARGERS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
04	--	--	04	15	15	10	60	2hrs. 30min.	--	--	100	04

Course Objectives

To make the students aware and understand:

1. Battery parameters
2. Different types of batteries
3. Charging infrastructure and charging methods

Course Contents:

Introduction: Introduction to battery technologies, Battery parameters : Cell and battery voltages, Charge (or Amphour) capacity, State of charge, Energy stored, Energy density, Specific power, Amphour (or charge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life and number of deep cycles.

EV Batteries: Lead Acid Batteries: Lead acid battery basics, Special characteristics of lead acid batteries, Battery life and maintenance, Battery charging, Summary. Nickel-based Batteries: Introduction, Nickel cadmium battery, Nickel metal, Nickel hydride batteries. Battery safety.

Sodium, Lithium and Other batteries: Sodium-based Batteries: Introduction, Sodium sulphur batteries, Sodium metal chloride (Zebra) batteries. Lithium Batteries: Introduction, The lithium polymer battery, The lithium ion battery, Aluminum Batteries: Introduction, The Aluminum Ion battery, Al-Ion battery challenges. Flow battery

Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

EV Charging: Battery Chargers: Charger classification and Standards, Charge equalisation, Conductive Charging: Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive Charging: (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods.

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. Power Electronics: Converters, Applications and Design, Mohan Undeland and Robbins.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.
3. The Handbook of Lithium-Ion Battery pack Design: Chemistry, Components, Types and Terminology, Warner, J. T. Elsevier, 2015.

Course Outcomes:

After completion of this course, student will be able to:

EE1603C.1 Elaborate various technical parameters of batteries.
EE1603C.2 Distinguish between various types of batteries used for EV applications.
EE1603C.3 Understand the charging infrastructure
EE1603C.4 List charging methods for EV
EE1603C.5 Analyse different battery charger for EV

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1603C.1	3	2	0	0	0	1	0	0	0	0	0	0	2	1	2
EE1603C.2	2	2	1	2	2	0	0	0	0	0	0	0	2	1	2
EE1603C.3	3	2	3	2	2	0	0	0	0	0	0	0	2	0	3
EE1603C.4	1	2	2	0	0	0	0	0	0	0	0	0	2	1	1
EE1603C.5	2	2	3	1	0	0	1	1	0	0	2	0	2	0	2

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1603C.1	3	2	-	-	-	1	-	-	-	-	-	2	1	2
EE1603C.2	2	2	1	2	2	-	-	-	-	-	-	2	1	2
EE1603C.3	3	2	3	2	2	2	1	-	-	-	-	2	-	3
EE1603C.4	1	2	2	-	-	-	-	-	-	-	-	2	1	1
EE1603C.5	2	2	3	1	-	2	1	1	-	-	2	2	-	2

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Course Code	EE1604A	Course Category	PE
Course Name	EHV AC TRANSMISSION		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-1	Ct-2	TA	ESE	ESE Duration	ICA	ESE		
03	01	-	04	15	15	10	60	2 hrs. 30 min.	-	-	100	04

Course Objectives:

To make the students aware and understand:

1. Different aspects of Extra High Voltage AC transmission system design and analysis.
2. Concept of Voltage gradients of conductors.
3. Electrostatic field and its effects over humans, animal and plants.

Course Contents:

Extra High Voltage AC Transmission: Introduction to EHV-AC transmission, transmission line trends & preliminary aspects, standard transmission voltages-power handling capacities and line losses mechanical aspects.

Electrostatic Field of EHV Lines: Electric shock & threshold currents, capacitance of long object, Effect of Electrostatic field on Human, Animal. Voltage Gradients of Conductors**:** Electrostatics – field of sphere gap surface voltage gradient on conductors – distribution of voltage gradient on sub conductors of bundle.

Over Voltages in EHV System: origin & causes, over voltage caused by switching operations, over voltage caused by interruption of low inductive current, over voltage caused by interruption of capacitive currents, Ferro-resonance overvoltage Power frequency voltage control, shunt & series compensation.

Lightning: Lightning strokes, lightening stroke to tower and midspan, Insulation coordination based on lightning, counterpoise.

Traveling Wave Theory: Traveling wave expression and solution- source of excitation-terminal conditions- open circuited and short-circuited end- reflection and refraction coefficients-Lumped parameters of distributed lines generalized constants-No load voltage conditions and charging current.

Text Books:

1. Extra High Voltage AC Transmission Engineering, Rakosh Das Begamudre, New Age International (P) Ltd.
2. HVAC and DC Transmission, by S. Rao, 3rd edition, Khanna Publishers, 2001

Reference Books:

1. Extra high voltage AC Transmission Engineering by Rakosh Das Begamudre , Wiley Eastem LTD.
2. EHV Transmission line Edison-Electric institution.
3. www.nptel.iitm.ac.in

Course Outcomes:

On completion of the course, students will be able to:

EE1604A.1 Learn about the trends in EHV AC Transmission.
EE1604A.2 Understand electrostatic field of EHV AC lines.
EE1604A.3 Examine the overvoltage phenomenon in EHV AC system.
EE1604A.4 Inspect lightning phenomenon in EHV AC lines.
EE1604A.5 Understand the concept of travelling waves.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1604A.1	2	0	0	0	0	0	0	0	0	0	0	0	2	1	0
EE1604A.2	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0
EE1604A.3	3	3	2	2	2	0	0	0	0	0	0	0	2	2	0
EE1604A.4	2	3	0	1	2	0	0	0	0	0	0	0	2	2	0
EE1604A.5	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1604A.1	2	2	1	2	3	1	-	-	-	-	-	-	2	1
EE1604A.2	2	2	1	2	2	-	-	-	-	-	-	-	2	1
EE1604A.3	3	2	2	2	2	-	-	-	-	-	-	-	2	-
EE1604A.4	2	2	2	-	-	1	1	-	-	-	-	-	2	1
EE1604A.5	2	2	3	1	2	-	-	-	-	-	2	-	2	-

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Course Code	EE1604B	Course Category	PE
Course Name	INTRODUCTION TO RENEWABLE ENERGY		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	--	04	15	15	10	60	2hrs. 30min.	--	--	100	04

Course Objectives:

To make the students aware and understand:

1. Energy scenario, energy sources and their utilization.
2. Principles of renewable energy conversion systems.
3. Energy conservation methods and different renewable energy technologies

Course Contents:

Energy Scenario: Indian energy scenario, different forms of energy, principles of renewable energy, renewable energy availability in India, renewable energy sources and features.

Solar Thermal Systems: Introduction to Solar and Thermal Systems, Energy conversion Principle and applications, solar water heaters, space cooling, solar distillation, solar cooking, solar green house, solar production of hydrogen, simple illustrative numerical.

Solar Photovoltaic Systems: Operating principle, concept of PV cell, module, array and array combination. Applications, battery charging, pumping, lighting. Simple illustrative numerical.

Wind energy system: Principle of wind energy conversion. Basic components of wind energy conversion system, classification of wind energy conversion system and design concepts. Extraction of power. Simple illustrative numericals.

Energy Storage systems: Mechanical energy storage, electrical energy storage, chemical energy storage, electromagnetic energy storage, thermal energy storage, biological storage.

Energy conservation: Economic concept of energy, Principle of energy conservation, energy conservation technology, energy audit and co-generation.

Text Books:

1. S. P. Sukhatme, Solar Energy - Principles of Thermal Collection and Storage, Second Edition, Tata McGraw-Hill, New Delhi 1996.
2. G. D. Rai, Non-conventional Sources of Energy, Khanna Publications.

Reference Books:

1. H. P. Gargand Jaipraksh, Solar Energy Fundamentals and Applications, Tata McGraw-Hill Publications
2. D. Mukharjee and S. Chakrabarti, Fundamentals of Renewable Energy Systems, New Age international Publication.
3. L. Umanand, Non-conventional Energy System, Web course: NPTEL, Course No. 22. Electrical Engineering, Email: ums@cedt.iiisc.ernet.in.

Course Outcomes:

After completion of the course students will able to:

EE1604B.1 Understand present energy scenario of India, energy sources/resources.
EE1604B.2 Understand Society's present needs and future energy demands.
EE1604B.3 Understand the Principles of renewable energy conversion systems.
EE1604B.4 Understand energy conservation methods,
EE1604B.5 Know about the energy auditing techniques.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1604B.1	2	0	0	0	0	2	3	1	0	0	0	0	2	0	0
EE1604B.2	2	2	1	2	2	2	2	1	0	2	3	0	2	0	1
EE1604B.3	2	2	1	2	2	2	2	1	0	2	3	0	2	0	1
EE1604B.4	2	2	1	2	2	2	3	1	0	2	3	0	2	0	1
EE1604B.5	2	0	0	2	2	2	2	1	0	2	3	2	2	0	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1604B.1	2	1	0	0	0	0	0	0	0	0	0	2	2	0
EE1604B.2	2	2	1	0	2	0	2	0	0	0	0	3	2	0
EE1604B.3	2	2	1	1	2	1	0	0	0	0	0	3	1	0
EE1604B.4	3	2	0	0	0	0	1	0	0	0	0	3	2	0
EE1604B.5	3	0	0	0	3	0	1	0	0	0	0	3	1	0

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Course Code	EE1604C	Course Category	PE
Course Name	EV MOTORS AND POWER CONVERTERS		

Teaching Scheme				Examination Scheme								
				Theory					Practical		Total	Credits
Th	Tu	Pr	Total	CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	01	--	04	15	15	10	60	2hrs. 30min.	--	--	100	04

Course Objectives:

To make the students aware and understand:

1. Power requirement of EV
2. Performance of various motors for EVs
3. Converters in EVs

Course Contents:

Vehicle Power: Vehicle Power requirement calculations: Rolling Resistance, air drag, hill climbing, acceleration forces.

EV AC and DC Motors: Requirement of EV motors, Comparison of EV motors, Basics of DC Motor, Torque speed characteristics, DC Motor dynamics, Speed Control, Four quadrant operation. Working principle and operation of Induction motor, Permanent Magnet Synchronous Motor (PMSM), Permanent Magnet Brush-less DC Motor (PMBLDC), Switched Reluctance Motor (SRM) and their Speed-Torque characteristics.

Converters: Understanding Power Electronics, Modern power devices, Basic rectifier, Controlled Rectifier, Basic Inverter circuits, Chopper Circuits, AC regulators.

Motor Control: Power Electronic Control of PMSM, SRM and PMBLDC and Induction motor.

Braking: Braking requirements of vehicle, methods of braking of DC motor and Induction Motor, regenerative braking and dynamic braking, coordinating electrical and mechanical brakes, braking control strategies.

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Fundamentals of Electrical Drives, G. K. Dubey, Narosa Publications
4. B. K. Bose, "Modern Power Electronics and AC Drives," Prentice Hall, 2002.
5. Power Electronics: Circuits, Devices, and Applications' by M. H. Rashid, Pearson Education India, 2014.
6. Power Electronics: Converters, Applications and Design by N. Mohan and T. M. Undeland, John Wiley& Sons, 2007.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Course Outcomes:

After completion of this course, student will be able to:

EE1604C.1 Calculate the power required for EV
EE1604C.2. Analyze the Electric motors used for EV
EE1604C.3 Analyze the converters for EV
EE1604C.4 Understand the motor control for EV operation
EE1604C.5 Analyze the braking operation in EV

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1604C.1	2	2	1	0	0	1	0	0	0	0	0	0	2	1	2
EE1604C.2	2	2	1	2	2	0	0	0	0	0	0	0	2	1	2
EE1604C.3	3	2	2	2	2	0	0	0	0	0	0	0	2	0	2
EE1604C.4	2	2	2	0	0	0	0	0	0	0	0	0	2	1	1
EE1604C.5	2	2	3	1	0	0	1	1	0	0	2	0	2	0	2

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1604C.1	2	2	1	2	3	1	-	-	-	-	-	-	2	1
EE1604C.2	2	2	1	2	2	-	-	-	-	-	-	-	2	1
EE1604C.3	3	2	2	2	2	-	-	-	-	-	-	-	2	-
EE1604C.4	2	2	2	-	-	1	1	-	-	-	-	-	2	1
EE1604C.5	2	2	3	1	2	-	-	-	-	-	2	-	2	-

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Course Code	EE1605						Course Category		VSE
Course Name	ELECTRICAL POWER-II LABORATORY								
Teaching Scheme				Examination Scheme					Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	02	02	--	--	--	--	--	25	25	50	01

Course Objectives:

To make the students aware and understand:

1. The symmetrical and unsymmetrical faults
2. Stability constraints in a synchronous grid
3. Evaluation power system stability

Minimum eight hands-on experiments related to the course contents of EE1601 Electrical Power – II to be performed. Representative list is as follows.

1. Simulation and analysis for a symmetrical three phase fault.
2. Simulation and analysis of unsymmetrical fault - LL, LG and LLG.
3. Solution of swing equation by point by point method
4. Solution of Swing equation by Euler method
5. Solution of Swing equation by Modified Euler method
6. Modelling and simulation of multi-machine power system
7. To study steady state stability.
8. Determination of steady state power limit of a transmission line.
9. To study optimum generation scheduling.
10. Visit to HV/EHV substation / power generating station.
11. To study EHV AC transmission line simulator.
12. Visit to HVDC station / Load Dispatch Centre
13. Visit to SCADA substation.

ICA - Internal Continuous Assessment shall be based on the practical record and knowledge /skills acquired. The performance shall assess experiment wise by using continuous assessment formats, A and B.

ESE - End Semester Exam for Practical shall be based on performance in one of the experiments and may be followed by sample questions.

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Course Outcomes:
After completion of this course, the students will be able to:

EE1605.1 Model and simulate different faults in power system.
EE1605.2 Simulate the steady transient operations.
EE1605.3 Perform various contingencies on power system and compute sensitivity factors.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
EE1605.1	3	2	1	2	3	0	0	0	0	0	0	1	2	1	2
EE1605.2	2	2	1	2	3	0	0	0	0	0	0	1	2	1	2
EE1605.3	2	2	1	2	3	0	0	0	0	0	0	1	2	1	2

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1605.1	3	2	1	2	3	0	0	0	0	0	1	2	1	2
EE1605.2	2	2	1	2	3	0	0	0	0	0	1	2	1	2
EE1605.3	2	2	1	2	3	0	0	0	0	0	1	2	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1606							Course Category		FP
Course Name	MINOR PROJECT									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	04	04	--	--	--	--	--	25	25	50	02

Course Objectives:

To make the students aware and understand:

1. The opportunity to demonstrate their competence in laboratory work and integrate the knowledge gained in courses studied.
2. Exercising maturity, initiative and creative ability.
3. Communication skills, both oral and written, to communicate results, concepts and ideas.

Course Contents:

Group of 8 students shall be permitted to work on minor project. The student(s) will carry out minor project based on one or more of the following aspects:

Prototype design, product preparations, working models, fabrication of set-ups, laboratory experiments, process modification/development, simulation, software development, integration of software and hardware, data analysis, survey, field visits (minimum three), case study, etc.

The students are required to submit a **10 to 15** page report based on the work carried out.

Internal Continuous Assessment (ICA): Internal Continuous Assessment shall be based on the project report and knowledge /skills acquired. The performance shall assess by using continuous assessment formats, A and B.

End Semester Examination (ESE): The ESE shall be based on the demonstration of the minor project work and may be followed by sample questions.

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Course Outcomes:

At the end of this course, students will be able to:

EE1606.1 Practice acquired knowledge within the chosen area of technology for project development.

EE1606.2 Reproduce, improve and refine technical aspects for engineering projects; and report effectively project related activities and findings.

EE1606.3 Work as an individual or in a team in development of technical projects.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1606.1	3	3	3	0	2	0	1	2	0	0	1	3	3	0	0
EE1606.2	0	0	3	2	3	0	2	0	0	0	2	2	2	3	3
EE1606.3	0	0	0	0	0	0	0	2	3	3	2	1	0	2	3

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1606.1	3	3	3	0	2	0	2	0	0	1	3	3	0	0
EE1606.2	0	0	3	2	3	0	0	0	0	2	2	2	3	3
EE1606.3	0	0	0	0	0	0	2	3	3	2	1	0	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1607	Course Category	MNC
Course Name	ELECTRICAL ESTIMATING AND COSTING		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
02	--	--	02	15	15	20	--	---	--	--	50	00

Course Objectives:

To make the students aware and understand:

1. Importance of estimation, specification and earthing.
2. Preparation of the schedule of materials with specifications and estimates for service mains.
3. Preparation of the schedule of materials with specifications and estimates for different types of electrical installations.

Course Contents:

Introduction: Meaning of estimation, purpose of estimating and the factors to be considered while preparing estimations, Meaning of tender/tender notice, quotation, comparative statement, purchase order and work order. Importance / purpose of IE Act and IE Rules. Meaning of earthing, touch potential and step potential, necessity of earthing, standard values of earth resistance for various installations, Pipe erthing and plate earting.

Service Mains: Meaning of service mains, code of Practice for service mains, types of service mains- Over Head Service Mains -materials and specifications, UG Service Mains - materials and specifications, schedules of materials and estimates for single phase OH service connection, three phase OH service connection, single phase UG service connection and three phase UG service connection

Lighting Installations: Interior Wiring types and their applications, factors to be considered while selecting the type of wiring system, materials required for Interior wiring and their specifications, Code of Practice for Lighting Installations, Prepare the schedule of materials for providing lighting and heating circuits and their estimates. Procedure for converting lighting to AEH installation

Power Installations: Code of Practice for Power Installations, materials required for power circuit wiring and their specifications, Prepare the layout diagram of machines showing clearances as per IS standards, Prepare the schedule of materials with specifications for workshops and their estimates, Determine the rating of motor for IP set and the concept (only)of pump house wiring.

Distribution Lines and Transformer Substations: Code of practice for Distribution Lines and Transformer centre, types of transformer centres - Pole mounted, plinth mounted, indoor and outdoor types. Determining the rating of Distribution Transformer. Write Specifications of the Distribution Transformer. Prepare the schedule of materials (only) for 3 phase 4 wire LT line, 11 KV HT Line-materials and their specifications, method of calculating various HT line materials and tapping structure, Concept of combined estimates. Prepare the schedule of materials (only) for 11 KV single circuits. HT line for Rural Electrification.

Substation Equipment and Auxiliaries: Code of practice for Transmission lines and substations, transmission line materials and their specifications, types of Towers, Prepare the schedule of materials (only) for 132 KV and 220 KV single circuit transmission lines. 33KV/11KV, 5 MVA Substations - Single Line diagram, list of Electrical equipment/ materials and auxiliaries (only), and their specifications.

Text Books:

1. Electrical Design Estimating and Costing, Raina. K. B. & Bhattacharya. S. K. New Age International
2. Substation Design and Equipment, P. V. Gupta, P. S. Satnam, Dhanpat Rai Publications

Reference Books:

1. A Course in Electrical Installation, Estimating & Costing, J B Gupta, S K Kataria & Sons.
2. Electrical estimating and costing, Surjith Singh, Danpat Rai & Co.
3. Electrical Power Station Design, M. V. Deshpande, Mc Graw Hill Companies

Course Outcomes:

After completion of the course, the students will be able to:

EE1607.1 Understand various types of materials required for wiring.
EE1607.2 Comprehend the estimation of a domestic installation.
EE1607.3 Know different systems of earthing.
EE1607.4 Comprehend the estimation of industrial installations.
EE1607.5 Comprehend the estimation of substations.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1607.1	2	0	0	0	0	0	0	0	0	0	0	0	2	1	0
EE1607.2	2	2	0	0	0	0	0	0	0	0	0	0	2	2	0
EE1607.3	3	3	2	2	2	0	0	0	0	0	0	0	2	2	0
EE1607.4	2	3	0	1	2	0	0	0	0	0	0	0	2	2	0
EE1607.5	2	1	0	0	0	0	0	0	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1607.1	2	0	0	0	0	0	0	0	0	0	0	2	1	0
EE1607.2	2	2	0	0	0	0	0	0	0	0	0	2	2	0
EE1607.3	3	3	2	2	2	0	0	0	0	0	0	2	2	0
EE1607.4	2	3	0	1	2	0	0	0	0	0	0	2	2	0
EE1607.5	2	1	0	0	0	0	0	0	0	0	0	1	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

EXIT COURSES (After B. Tech. III Year)

Course Code	EE1611	Course Category	EX
Course Name	SOLAR AND LED TECHNICIAN		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	08	08	--	--	--	--	--	50	--	50	04

Course Objectives:

To make the students aware and understand:

1. Fundamental concepts of solar cell
2. Solar cell technologies.
3. Solar photovoltaic and solar thermal system.

Course Contents:

Minimum eight experiments/assignments related to the following course contents:

Basic concepts of Electricity and Electronics:
Define voltage, current, power and energy Explain different types of connections Identify the use of a multi meter basics of wiring, colour coding of wires, wiring diagram, wiring requirements, voltage loss in wires, measurement of electrical parameters, measurement of voltage, current and resistance, measurement of electrical power and energy importance of an earthling system, Earthling System, Basic of Electronic Components, passive components, active components, Identify electronic components Basics of LED and Lighting System History and working of an LED, types of LED, factors affecting the life of an LED, specifications of an LED, Indoor and outdoor lighting system

Basic Concept of Solar Technology:
Solar Technology and Photovoltaic System (PV) System, Solar energy, irradiance, irradiation, air mass, band gap, solar thermal technology, solar photovoltaic technology. Applications of solar PV technology, solar cell, parameters of solar cell, types of Solar cells

Solar PV System:
Working of solar PV panel, panel construction, PV solar panels array configurations, performance of solar PV system, introduction to on grid and off grid solar PV system, types of solar PV technologies

Components of a PV system:
Types of PV modules and their characteristics, Batteries- components of batteries, types of batteries , types of PV modules and their characteristics, parameters of batteries, battery terminal voltage, battery storage capacity, charge controllers, inverter, mounting structures, load. Solar PV Modules, rating of PV modules, state of charge(SOC), depth of discharge (DOD), self-discharge rate, battery efficiency, cables and connectors

Installation and Repair of Solar based LED Lighting System:
Introduction to solar LED technician, pre installation activities, structures for panel installation, considerations for solar rooftop panels, advantages of rooftop panels non roof structures, post installation activities. Repair solar based LED lighting system. Routine maintenance & Repair, maintenance of PV system, trouble shooting

Text Books:

1. Deepak Kumar Yadav, "Solar Technician (Electrical) Theory ", Neelkath publishers, 2023.
2. Ramchandra Pode, "Solar Lighting (Green Energy & Technology)", Springer 2013.

References Books:

1. "Solar LED Technician Handbook", Electronics Sector Skills Council of India, 2022.
2. Chetan Sing Solanki, "Solar Photovoltaic's: Fundamentals, Technologies and Applications", PHI Publishers.
3. Chetan sing Solanki, "Solar Photovoltaic Technology and Systems: A manual for Technicians, Trainers and Engineers", PHI Publishers

Course Outcomes:
After completion of the course, the students will be able to:

EE1611.1	Define the terminologies related to solar technology
EE1612.2	Identify the working process of PV panels.
EE1613.3	Connect PV panels in parallel and series.
EE1614.4	Fix the LED lighting system
EE1615.5	Define roles and responsibilities of solar and LED technician

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1611.1	3	1	3	0	0	0	0	0	3	0	2	0	3	2	1
EE1611.2	2	3	2	3	0	0	0	0	2	0	3	0	1	3	0
EE1611.3	2	2	3	2	0	0	0	0	2	0	2	0	2	2	2
EE1611.4	2	2	3	2	0	0	0	0	2	0	2	0	2	3	3
EE1611.5	2	2	3	0	0	0	0	0	2	0	3	0	1	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1611.1	3	3	2	2	2	3	2	3	3	2	3	3	2	1
EE1611.2	2	3	2	3	0	0	0	0	2	0	2	1	3	0
EE1611.3	2	2	3	2	0	0	0	0	2	0	2	2	2	2
EE1611.4	2	2	3	2	0	0	0	0	2	0	2	2	3	3
EE1611.5	2	2	3	0	0	0	0	0	2	0	2	1	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1612	Course Category	EX
Course Name	EV CHARGING STATION TECHNICIAN		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	08	08	--	--	--	--	--	50	--	50	04

Course Objectives:

To make the students aware and understand:

1. The evolution of electric vehicles
2. The need for charging Infrastructure
3. Recommended setting, functional, communication protocol and safety related checks required for effective operation of charging station systems.

Course Contents:

Minimum eight experiments/assignments related to the following course contents:

Electric Vehicle Charging System:

Evolution of Electric Vehicle Charging System, EV – Electric Vehicle, BEV – Battery Electric Vehicle, HEV – Hybrid Electric Vehicle, PHEV – Plug-in Hybrid electric Vehicle, EVB – Electric Vehicle Battery, AC – Alternating Current, DC – Direct Current Regenerative Braking, Portable Charger, Onboard Charger, EVSE Connector, components of electric Vehicle Supply Equipment (EVSE), types of EVCS and future trends

Organizational Context:

Stake holders for creating standards, organisation for EVSE standards, and organization for communication standards, general stake holderds, charger type and its applications, types of EVSE in India. Charging management system (CMS), communication protocols, charging station standard in India, vehicle types and charging requirements, certification bodies, regulatory bodies, duties and responsibilities of EV charging station technician

Erection and Installation of EV charging Station:

Basics of electricity and basic Laws in electricity, measurements of electrical quantities, basics of electrical and electronic components, types of wiring, earthing and insulation, preparation for the installation of EVCS, basic requirements, pre installation checks and assessing EVCS components, permission and authorization requirements, installation of all charging components, commencing of charging station

Operation of various types of EV Charging Stations

Recommended settings and functional checks, daily safty checks. Charging station indicator lights, starting and monitoring of charging session, documenting the usages and issues with the charging sation, standard operation procedure for flooding

Maintenance of Various Types of Electric Vehicle Charging Stations

Charging system equipment maintenance, periodic inspection and preventive maintenance process, standard operating procedures for repair and maintenance, periodic check of distribution transformer, software installation and trouble shooting, health and safety practices, charging station fire and safety practices

Text Books:

1. "Handbook of Electric Vehicle Charging Infrastructure Implementation", Niti Ayog.
2. "Guide lines for EV charging", Ministry of Power.
3. "Safety Guide lines for EV charging stations", Centre Electricity Authority.

References Books:

1. "Fundamentals of EV charging technology and its integration", Niti Ayog, GIZ and IIT Bombay.
2. "Residential EV charging Guide book", Dialog and Development Commission, Delhi and WRI.
3. "EV charging Guide book for shopping malls", NDC Transport Initiative for Asia.
4. "Work place charging Guide book", NDC Transport Initiative for Asia.

Course Outcomes:

After completion of the course, the students will be able to:

EE1612.1 Understand the components of EV charging systems.
EE1612.2 Understand the responsibilities of an EV charging station Technician
EE1612.3 Identify the tools needed to measure critical parameters.
EE1612.4 Investigate the performance of charging stations by testing
EE1612.5 Differentiate the capabilities of different charging standards and chargers

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1612.1	3	3	3	3	3	3	0	0	2	0	3	3	2	2	2
EE1612.2	3	3	3	3	3	3	0	0	2	0	3	3	2	2	2
EE1612.3	3	3	3	3	3	3	2	0	2	0	3	2	2	2	2
EE1612.4	3	3	3	3	3	3	2	0	2	0	2	3	2	2	2
EE1612.5	3	3	3	3	3	3	2	0	2	2	3	3	2	2	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1612.1	3	3	2	2	2	3	2	3	3	2	3	2	1	3
EE1612.2	2	3	2	3	0	0	0	0	2	0	2	3	0	2
EE1612.3	2	2	3	2	0	0	0	0	2	0	2	2	2	2
EE1612.4	2	2	3	2	0	0	0	0	2	0	2	3	3	2
EE1612.5	2	2	3	0	0	0	0	0	2	0	2	2	3	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1613	Course Category	EX
Course Name	INTERNSHIP /TECHNICAL PROJECT		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	16	16	--	--	--	--	--	100	--	100	08

Course Objectives:

To make the students aware and understand:

1. To develop skills in doing literature survey, technical presentation and report preparation
2. To perceive the idea and decide the objectives of project from literature survey
3. To enable project identification and execution of preliminary works on project

Course Contents:

1. Preferably more than 25 % projects shall be Industry oriented / Research based.
2. Exhaustive survey of literature based on a clear definition of the s cope and focus of the topic should be carried out by the students.
3. Students should finalize the topic for the project after literature survey in consultation with the Guide.
4. The **Synopsis/Abstract** on the selected topic should be submitted to the H.O.D. for approval.
5. On approval of the topic, students should initiate the topic based work.
6. Students should complete implementation of ideas given in synopsis, so that project work should be completed before end of semester.
7. Students shall submit the final project report in proper format as per guide lines given on the college website which shall include the work of both semesters.
8. For uniform and continuous evaluation, evaluation committee for each group s hall be formed by Program Head in which guide must be a member. Internal marks should be awarded by committee at the end of semester based on continuous evaluation.
9. Final examination of project shall include demonstration, presentation of complete work and oral examination based on the project work.

INDUSTRY INTERNSHIP PROJECT

I. The aim of Industry Internship Project is to closely work with industry to apply theoretical knowledge in a real-world context providing real industrial project enabling learning focused on the application knowledge. This gives a student an opportunity to make their first traces in the industrial reality and start building a personal network, an important prerequisite for a successful industry career.

II. The purpose of the INDUSTRY INTERSHIP PROJECT to solve real industrial problems by following established engineering methods, working in teams, and effectively communicating with various stakeholders.

III. The students can work in group decided by the department as per availability of Faculty. The individual students can also undertake the Industry Institute Project subject to availability of Industry Mentor/Guide. Students/Group selects the industry which is ready to provide INDUSTRY INTERSHIP PROJECT through oral/written communication. Once selected the student group has to visit the industry/stay as per need. The institute will not provide any assistance in Travel and Stay. The student/ Group need to submit acceptance letter from Industry regarding allowing the student/groups for INDUSTRY INTERSHIP PROJECT stating the Project name or research area.

IV. Each group has an Industry Project Guide and Institute Project Guide. The meeting with Project guide is once within week/two week at Institute. These meetings typically include assistance in finding solutions recent problems in the projects, technical support on applied software packages, and support with writing the final report. The project groups do multiple company visits where they meet the industrial contacts to formulate the problem, collect data and information, and gain necessary experiences from the industry.

V. Furthermore, INDUSTRY INTERSHIP PROJECT includes seminars aiming to give the students experience of communicating to a larger audience, working in teams, etc. The Project monitoring will be done by Institute Guide to know whether learning objective is achieved or not.

VI. The INDUSTRY INTERSHIP PROJECT undergone individual student/ Group will have to submit following documents on the successful completion of Industry Institute Project

1. Authenticated attendance record from Industry internship project mentor/supervisor/Guide
2. Industry internship project signed by Industry Mentor/Guide
3. Industry internship project Completion Letter by Industry Mentor/ Guide
4. Project evaluation report signed by Industry Mentor/ Guide

Note:

ICA: The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge/skill acquired. Oral examination shall be conducted on the Project report, by the panel of examiners consisting of Project Guide, Course Coordinator and Expert appointed by Program Head.

Course Outcomes:

After completion of the course, the students will be able to:

EE1613.1 Perceive the idea and decide the objectives of project from literature survey
EE1613.2 Integrate information from multiple sources.
EE1613.3 Identify, analyze, and solve problems creatively through sustained critical investigation.
EE1613.4 Implement the idea with effective leadership in prescribed schedule
EE1613.5 Prepare the effective technical document related to work carried out

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1613.1	3	1	3	0	0	0	0	0	3	0	2	0	3	2	1
EE1613.2	2	3	2	3	0	0	0	0	2	0	3	0	1	3	0
EE1613.3	2	2	3	2	0	0	0	0	2	0	2	0	2	2	2
EE1613.4	2	2	3	2	0	0	0	0	2	0	2	0	2	3	3
EE1613.5	2	2	3	0	0	0	0	0	2	0	3	0	1	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1613.1	3	1	3	3	3	3	3	3	3	2	3	3	2	1
EE1613.2	2	3	2	3	0	0	0	0	2	0	3	1	3	0
EE1613.3	2	2	3	2	0	0	0	0	2	0	2	2	2	2
EE1613.4	2	2	3	2	0	0	0	0	2	0	2	2	3	3
EE1613.5	2	2	3	0	0	0	0	0	2	0	3	1	2	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1621	Course Category	PEH
Course Name	TRANSMISSION LINES AND ELECTROMAGNETIC WAVES		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	--	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Various concepts of transmission lines and impedance measurements
2. Concept of Maxwell equations and polarisation of an electromagnetic wave
3. Wave characteristics in different media, and parallel plate and rectangular waveguides and their modes

Course Contents:

Transmission Lines: Lossless transmission lines, Wave Equations, Introduction to finite difference method, Octave/Matlab simulation of wave equation, Octave/Matlab simulation of Telegrapher's equation, Reflections and reflection coefficients.

AC Signals in Transmission Lines: AC signals in loss-less transmission lines, Transmission lines with losses, Octave simulation of transmission lines with losses, Voltage reflection coefficient and standing wave ratio, Graphical representation of reflection coefficient, Impedance matching using Smith chart, Demonstration of Impedance matching using VNA

Electromagnetic waves and Maxwell's Equation: Transmission Line Limitations and Maxwell's Equation, Maxwell's Curl Equation, Octave simulation of an Electromagnetic Wave Equation, Polarisation of an Electromagnetic Wave, Octave Simulation of different types of Polarisation, Electromagnetic Waves in a conductive Medium

Plane Waves: Plane waves, Plane Waves at normal incidence, Plane waves at Oblique Incidence – I, II, III, Octave simulation of perpendicular polarisation, Dielectric-ideal conductor interface

Waveguide: Parallel plate waveguide, Rectangular Waveguide, Octave simulation of modes of a Rectangular Waveguide, Phase Velocity and Group velocity, Octave

simulation of Field pattern of a parallel plate waveguide, Cavity resonator and Real life applications of waveguides and cavity

Text Books:

1. E. C. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2000.
2. Matthew N. O. Sadiku, Elements of Electromagnetics, 3rd Edition, Oxford University Press, 2001.

Reference Books:

1. John D. Krauss, Electromagnetics, 4th Edition, McGraw- Hill publications, 1991.
2. Joseph Edminister, Vishnu Priye, Electromagnetics, 2nd Edition, Schaum's outline series, Tata McGraw-Hill publications, 2006.
3. R K Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill Education, 2005.

Course Outcomes:

After completion of the course, the students will be able to:

EE1621.1 Explain transmission line parameters with equations and Reflections and Reflection coefficients

EE1621.2 Describe Smith chart graphically to determine transmission line parameters and analyze the applications of the Smith Chart

EE1621.3 Apply the Maxwell equations to analyze the time varying behaviour of EM waves and polarisation of an electromagnetic wave

EE1621.4 Illustrate plane wave propagation at media Interface

EE1621.5 Calculate Brewster angle, critical angle and total internal reflection and demonstrate the applications of waveguides and cavity in real life

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1621.1	1	2	0	0	0	0	0	0	0	0	0	0	1	0	0
EE1621.2	2	2	0	0	0	0	0	0	0	0	0	0	1	0	0
EE1621.3	3	2	2	3	1	0	0	0	0	0	0	0	2	0	0
EE1621.4	3	2	2	3	1	0	0	0	0	0	0	0	2	0	0
EE1621.5	2	2	3	1	0	0	2	0	0	0	0	0	1	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1621.1	1	2	0	0	0	0	0	0	0	0	0	1	0	0
EE1621.2	2	2	0	0	0	0	0	0	0	0	0	1	0	0
EE1621.3	3	2	2	3	1	0	0	0	0	0	0	2	0	0
EE1621.4	3	2	2	3	1	0	0	0	0	0	0	2	0	0
EE1621.5	2	2	3	1	0	0	2	0	0	0	0	1	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1622							Course Category		PEH
Course Name	INDUSTRIAL AUTOMATION AND CONTROLS									
Teaching Scheme				Examination Scheme						Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
--	--	--	--	15	15	10	60	--	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. Overall exposure to the technology of Industrial Automation and Control
2. Advantage and architecture of automation systems
3. Industrial communication and embedded computing and CNC Machines

Course Contents:

Introduction to Industrial Automation, Architecture of Industrial Automation Systems, Measurement Systems Characteristics, Data Acquisition Systems

Introduction to Automatic Control, P-I-D Control, PID Control Tuning, Feed forward Control Ratio Control, Time Delay Systems and Inverse Response Systems, Special Control Structures

Introduction to Process Control and Sequence Control, PLC, RLL Scan Cycle, Simple RLL Programs, RLL Elements and RLL Syntax, A Structured Design Approach to Sequence Control, PLC Hardware Environment

Flow Control Valves, Hydraulic Control Systems, Industrial Hydraulic Circuit, Pneumatic Control Systems, Energy Savings with Variable Speed Drives, Introduction to CNC Machines

The Fieldbus Network and Higher-Level Automation Systems

Text Books:

1. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House, 2013
2. Chemical Process Control, An Introduction to Theory and Practice, George Stephanopoulos, Prentice Hall India, 2012

Reference Books:

1. Electric Motor Drives, Modelling, Analysis and Control, R. Krishnan, Prentice Hall India, 2002
2. Hydraulic Control Systems, Herbert E. Merritt, Wiley, 1991

Course Outcomes:

After completion of the course, the students will be able to:

EE1622.1 Understand the concept of Industrial Automation
EE1622.2 Estimate characteristics of Measurement Systems and data Acquisition Systems
EE1622.3 Examine and analyse the performance of Automatic Control components
EE1622.4 Comprehend RLL Programs, RLL Elements and RLL Syntax
EE1622.5 Design a simple sequence control on PLC

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1622.1	1	0	2	2	0	0	0	0	0	0	0	0	2	2	1
EE1622.2	2	1	1	1	0	0	0	0	0	0	0	0	1	0	1
EE1622.3	0	2	1	1	0	0	0	0	0	0	0	0	3	2	0
EE1622.4	2	1	0	0	0	0	1	0	0	0	0	0	2	0	1
EE1622.5	0	1	1	1	0	0	0	0	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1622.1	1	0	2	2	0	0	0	0	0	0	0	2	2	1
EE1622.2	2	1	1	1	0	1	1	0	0	0	0	1	0	1
EE1622.3	1	2	1	1	2	0	0	0	0	0	0	3	2	0
EE1622.4	2	1	0	0	0	0	1	0	0	0	0	2	0	1
EE1622.5	0	1	0	1	0	0	0	0	0	0	0	2	0	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1631	Course Category	PER
Course Name	RESEARCH PROJECT STAGE - II		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT-I	CT-II	TA	ESE	ESE Duration	ICA	ESE		
--	--	12	12	--	--	--	--	--	100	100	200	06

Course Objectives:

To make the students aware and understand:

1. Research design, including the sampling size and techniques
2. Relevant data and analyze it using modern data processing tools/Carry out experimentation.
3. Improving the ability of presentation skill and communication techniques

Course Contents:

Prepare the research design, including the sampling size and techniques and the statistical tools for the analysis of for the research topic decided in Stage-I (V Semester).

Collect the relevant data, analyze and interpret the same using modern data processing tool, and test the hypotheses if necessary.

Develop a plan for preparing a report. Publish review paper in peer view journal/Scopus indexed journal.

The faculty supervisor will assess the method and procedures used by the learner.

Internal Continuous Assessment (ICA):

At the end of semester, the work carried shall be evaluated by three-member committee constituted by Head of Department.

End Semester Examination (ESE):

The internal and external examiner appointed by the competent authority will assess the research work carried out by the student through oral presentation and demonstration (if any).

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Course Outcomes:

After completion of the course, the students will be able to:

EE1631.1 Analyze and interpret data to produce useful information.

EE1631.2 Show in-depth skill to use some laboratory, modern tools and techniques.

EE1631.3 Communicate results, concepts, analyses and ideas in written and oral form.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1631.1	0	3	3	3	0	0	2	3	0	0	2	2	0	2	0
EE1631.2	3	0	0	0	3	0	0	0	0	0	0	3	3	0	0
EE1631.3	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1631.1	2	1	0	0	0	0	0	0	0	0	0	2	2	0
EE1631.2	2	2	1	0	2	0	2	0	0	0	0	3	2	0
EE1631.3	2	2	1	1	2	1	0	0	0	0	0	3	1	0

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	EE1641	Course Category	MN
Course Name	ELECTRICAL POWER		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. The fundamental concepts of power systems engineering
2. The concepts of how electric power is created and transmitted to urban centres and distributed to consumers
3. Mathematical model of a power system

Course Contents:

Introduction and basic concepts of Power Systems

Evolution of power systems, structure of power systems, Power system scenario in India, relevant IS codes, concept of regional and National GRID, overview of conventional and non-conventional power generation. Complex power: Introduction, concept of real, reactive and complex power and their effects on power system operation ac and dc transmission concepts.

Representation of power systems component

Single phase representation of balanced three phase system, Single line impedance or reactance diagrams. Per unit system: Basic concept, p.u representation of power systems components.

Models and performance of transmission line power system components

Transmission line models - short, medium and long lines, voltage and current waves, surge impedance, loading of transmission line, phenomenon of Corona, complex power flow through transmission lines, power transmission capability, Ferranti effect, methods of voltage control.

Power Flow Analysis

Power flow equations and techniques, Y Bus formation Gauss-Seidal method, Newton-Raphson method, comparison of power flow methods, Load flow problem (Not more than 3 buses)

Text Books:

1. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003
2. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
3. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.

Reference Books:

1. R. Bergen & Vijay Vittal , "Power System Analysis", Pearson, 2000
2. L. P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006
3. G. L. Kusic, "Computer aided power system analysis", Prentice Hall India, 1986
4. A. J. Wood, "Power generation, operation and control", John Wiley, 1994
5. P. M. Anderson, "Faulted power system analysis", IEEE Press, 1995

Course Outcomes:

After completion of the course, the students will be able to:

EE1641.1 Get the knowledge of power system and its components, structure, evolution and National level scenario

EE1641.2 Estimate the parameters of transmission line, understand its operation, role and select the model for various studies

EE1641.3 Analyze different power system components in per unit system

EE1641.4 Evaluate symmetrical and unsymmetrical faults, compute fault currents and use the information for protection purpose

EE1641.5 Create a mathematical model of a power system

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1641.1	2	2	1	1	2	2	2	2	0	1	1	1	2	1	2
EE1641.2	2	1	1	2	2	1	2	1	0	1	1	1	2	1	2
EE1641.3	1	3	1	2	2	1	2	1	0	1	1	1	2	1	2
EE1641.4	1	3	0	2	2	1	1	1	0	1	1	1	2	2	2
EE1641.5	1	1	1	3	2	1	3	3	0	1	1	1	1	1	3

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1641.1	3	2	1	1	2	2	2	2	3	1	3	2	1	2
EE1641.2	3	2	1	1	2	2	2	2	3	1	3	2	1	2
EE1641.3	3	2	1	1	2	2	2	2	3	1	3	2	1	2
EE1641.4	3	2	1	1	2	2	2	2	3	1	3	2	1	2
EE1641.5	3	2	1	1	2	2	2	2	3	1	3	2	1	2

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	EE1642	Course Category	MN
Course Name	POWER ELECTRONICS		

Teaching Scheme				Examination Scheme								Credits
Th	Tu	Pr	Total	Theory					Practical		Total	
				CT1	CT2	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	15	15	10	60	2hrs. 30min.	--	--	100	03

Course Objectives:

To make the students aware and understand:

1. The role of Power Electronics in society.
2. To select and use various power electronics devices.
3. To analyze AC/DC, DC/DC, DC/AC converters.

Course Contents:

Introduction to Power Electronics and Power Devices:

Applications, definitions and nature of power electronic circuits. Components of a power electronic system

Ideal switch, diode static characteristics, diode dynamic characteristics, introduction to diac and triac. SCR - operation, static and dynamic characteristic. Bipolar junction transistor - operation, static and dynamic characteristics

MOSFETs and IGBTs - operation, static and dynamic characteristics, parallel operation and loss calculation. Introduction to SiC and GaN devices

Gate and Base Drive Circuits and Protection of Devices:

Preliminary design considerations, dc-Coupled drive circuits, electrically isolated drive circuits, Cascode-connected drive circuits, thyristor drive circuits, power device protection in drive circuits, circuit layout considerations.

Non-polarised RC snubber, Polarised switching-aid circuits: The polarized turn-off snubber circuit - assuming a linear current fall, The turn-off snubber circuit - assuming a sinusoidal current fall, The polarized turn-on snubber circuit - with air core (non-saturable) inductance, The polarized turn-on snubber circuit - with saturable ferrite inductance, The unified turn-on and turn-off snubber circuit. Snubbers for bridge legs.

Line-frequency diode rectifiers and phase-controlled rectifiers:

Diode bridge rectifiers: Single phase Half wave with R load, R-L load. Single phase Full bridge rectifier with dc link capacitive filter, issue of harmonics. Three phase Full bridge rectifier with dc link capacitive filter, issue of harmonics.

Phase-controlled rectifiers: Single phase fully-controlled AC to DC converter: Principle of operation, issue of line commutation, continuous mode of conduction: expression for average output voltage, discontinuous mode of conduction (Operation only), analysis with R-L-E load, significance of R-L-E load, operation as an inverter: constraints for line commutation. Dual converter: motivation, input displacement factor, distortion factor, harmonics, effect of source inductance.

Single phase half-controlled converter: Operating principle, input displacement factor, modes of operation in the voltage-current plane.

DC- DC Power Converters:

Limitations of Linear Power supplies, switched power supplies (Buck, Buck-Boost, Boost, Cuk, Fly-back and Forward Converters) (Operation only).

DC- AC Power Converters:

Principle of operation of Inverters: Half bridge, full bridge, three phase- six step operation (Operation only). Introduction to PWM techniques: Single, Multiple and Sinusoidal PWM.

Text Books:

1. Power Electronics – Converters, Applications and Design, Mohan, Undemand, Robbins, 3rd Ed., John Willey & Sons, 2004.
2. Power Electronics - Circuits Devices and Application, M. H. Rashid 2nd Ed., Prentice Hall of India (PHI) Pvt. Ltd., New Delhi, 2003.

Reference Books:

1. Cyril W. Lander, “Power electronics”, 3rd Ed., McGRAW-HILL Publishing Company, 1993.
2. Power Electronics–Devices, Drivers and Applications, B. W. Williams, John Wiley, 2005
3. Power Electronics Principles and Applications, Joseph Vithyathil, Tata MC-Graw-Hill Edition, 2010

Web Resources:

1. http://www.nptel.iitm.ac.in
2. www.ocw.mit.edu

Course Outcomes:

At the end of this course, students will be able to:

EE1642.1 Understand the role of semiconductor devices and power electronics in control and conversion of electrical power.
EE1642.2 Develop designing skills for device fabrication and protection.
EE1642.3 Analyse diode and phase-controlled rectifiers.
EE1642.4 Compare various DC-DC power converters and understand their working.
EE1642.5 Apply various PWM techniques to DC-AC power converters and understand inverters working.

CO–PO–PSO Mapping as per NBA Jan-2016 Format:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE1642.1	2	0	1	0	0	1	1	0	0	0	0	1	2	1	1
EE1642.2	3	2	3	3	2	0	0	0	0	0	0	0	3	0	0
EE1642.3	2	3	2	2	0	0	0	0	0	0	0	0	3	0	0
EE1642.4	3	2	1	1	0	0	1	0	0	0	0	0	2	0	0
EE1642.5	3	2	1	1	0	0	0	0	0	0	0	0	2	0	0

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CO–PO–PSO Mapping as per NBA July-2024 Format [w.e.f. from 01 Jan 2025]:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
EE1642.1	2	0	1	0	0	1	1	0	0	0	1	2	1	1
EE1642.2	3	2	3	3	2	0	0	0	0	0	0	3	0	0
EE1642.3	2	3	2	2	0	0	0	0	0	0	0	3	0	0
EE1642.4	3	2	1	1	0	0	1	0	0	0	0	2	0	0
EE1642.5	3	2	1	1	0	0	0	0	0	0	0	2	0	0

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