Regulation 2023

Program Structure

1030 Diploma in Electrical and Electronics Engineering

Program Outcomes (PO's)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability, attitude, and behavior that students acquire throughthe program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during theprogram. As such, POs define the professional profile of an engineering diploma graduate.

NBA has defined the following seven POs for an Engineering diploma graduate:

PO1 : Basic and Discipline-specific knowledge: Apply knowledge of basic mathematics, science and engineeringfundamentals and an engineering specialization to solve engineering problems.

PO2 : Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods.

PO3 : Design/ development of solutions: Design solutions for well-defined technical problems and assist with thedesign of systems components or processes to meet specified needs.

PO4 : Engineering Tools, Experimentation, and Testing: Apply modern engineering tools and appropriatetechniques to conduct standard tests and measurements.

PO5 : Engineering practices for society, sustainability and environment: Apply appropriate technology in thecontext of society, sustainability, environment and ethical practices.

PO6 : Project Management: Use engineering management principles individually, as a team member or as a leaderto manage projects and effectively communicate about well-defined engineering activities.

PO7 : Life-long learning: Ability to analyze individual needs and engage in updating in the context of technologicalchanges.

GOVERNMENT OF TAMILNADU

DEPARTMENT OF TECHNICAL EDUCATION

DIPLOMA IN ENGINEERING & TECHNOLOGY

REGULATION 2023

1030 DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (FULL TIME)

CREDIT DISTRIBUTION

Semester	No of Courses	Periods	Credits
Semester I	8	640	20
Semester II	9	640	20
Semester III	8	640	21
Semester IV	7	640	20
Semester V	8	640	21
Semester VI	3	665	18
Total	43	3865	**120**

1030 DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (FULL TIME) REGULATION 2023

SEMESTER - III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030233110	Electrical Machines I	4-0-0	60	4	Theory
2.	Program Core	Theory	1030233210	Electrical Circuit Theory	4-0-0	60	4	Theory
3.	Program Core	Practicum	1030233340	Sensors and Measurement	1-0-4	75	3	Practical
4.	Program Core	Practicum	1030233440	Analog and Digital Electronics	1-0-4	75	3	Practical
5.	Engineering Science	Practicum	1030233540	Programming in C	1-0-2	45	2	Practical
6.	Program Core	Practical/Lab	1030233620	Electrical Machines I Practical	0-0-4	60	2	Practical
7.	Open Elective	Advanced Skill Certification	1030233760	Advanced Skills Certification - 3	0-0-4	60	2	NA
8.	Humanities & Social Science	Integrated Learning Experience	1030233880	Growth Lab	-	30	0	-
9.	Audit Course	Integrated Learning Experience	1030233881	Induction Program II	-	16	0	-
10.	Audit Course	Integrated Learning Experience	1030233882	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11.	Audit Course	Integrated Learning Experience	1030233883	Shop floor Immersion	-	8	0	-
12.	Audit Course	Integrated Learning Experience	1030233884	Student-Led Initiative	-	22	0	-
13.	Audit Course	Integrated Learning Experience	1030233885	Emerging Technology Seminars	-	8	0	-
14.	Audit Course	Integrated Learning Experience	1030233886	Health & Wellness	0-0-2	30	1	NA
Test & Revisions (60) + Library (15)					-	75	-	-
				Total	-	**640**	**21**	-

SEMESTER - IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030234110	Electrical Machines II	4-0-0	60	4	Theory
2.	Program Core	Theory	1030234210	Generation, Transmission and Distribution	4-0-0	60	4	Theory
3.	Program Core	Practicum	1030234340	Microcontroller and Embedded Systems	1-0-4	75	3	Practical
4.	Program Core	Practicum	1030234440	Electrical CAD Design	1-0-4	75	3	Practical
5.	Program Core	Practicum	1030234540	Servicing of Electrical Appliances	1-0-2	45	2	Practical
6.	Program Core	Practical/Lab	1030234620	Electrical Machines II Practical	0-0-4	60	2	Practical
7.	Open Elective	Advanced Skill Certification	1030234760	Advanced Skills Certification - 4	0-0-4	60	2	NA
8.	Audit Course	Integrated Learning Experience	1030234882	I&E/ Club Activity/ Community Initiatives	-	30	0	-
9.	Audit Course	Integrated Learning Experience	1030234883	Shop floor Immersion	-	8	0	-
10.	Audit Course	Integrated Learning Experience	1030234884	Student-Led Initiative	-	24	0	-
11.	Audit Course	Integrated Learning Experience	1030234885	Emerging Technology Seminars	-	8	0	-
12.	Audit Course	Integrated Learning Experience	1030234886	Health & Wellness	-	30	0	-
13.	Audit Course	Integrated Learning Experience	1030234887	Special Interest Groups (Placement Training)	-	30	0	-
		Test & Revisions (60) + Library (15)			-	75	-	-
				Total	-	**640**	**20**	-

1030 DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (FULL TIME)
REGULATION 2023

SEMESTER - V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030235110	Power System Protection and Utilization	3-0-0	45	3	Theory
2.	Program Core	Theory	1030235210	Electric Vehicle Technology	3-0-0	45	3	Theory
3.	Program Core	Practicum	1030235340	Power Electronics	1-0-4	75	3	Practical
4.	Program Core	Practicum	1030235440	PLC and Automation	1-0-4	75	3	Practical
5.	Program Elective	Practicum	103023554x	Elective -1	1-0-4	75	3	Practical
6.	Humanities & Social Science	Practicum	1030235654	Innovation and Start-ups	1-0-2	45	2	Project
7.	Project / Internship	Project/Internship	1030235773	Industrial Training* [Summer Vacation - 90 Hours]	-	-	2	Project
8.	Open Elective	Advanced Skill Certification	1030235860	Advanced Skills Certification - 5	0-0-4	60	2	NA
9.	Audit Course	Integrated Learning Experience	1030235981	Induction program III	-	40	0	-
10.	Audit Course	Integrated Learning Experience	1030235984	Student-Led Initiative	-	30	0	-
11.	Audit Course	Integrated Learning Experience	1030235986	Health & Wellness	-	30	0	-
12.	Audit Course	Integrated Learning Experience	1030235987	Special Interest Groups (Placement Training)	-	40	0	-
Test & Revisions (60) + Library (15)					-	75	0	-
				Total	-	635	21	-

** Internship shall be offered in the summer break between 4th and 5th semester followed by a review and award of credits in the 5th semester*

Elective - 1:

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Practicum	1030235541	IoT And Application	1-0-4	75	3	Practical
2.	Program Elective	Practicum	1030235542	Computer Hardware and Networking	1-0-4	75	3	Practical
3.	Program Elective	Practicum	1030235543	Control of Electrical Machines	1-0-4	75	3	Practical
4.	Program Elective	Practicum	1030235544	Auto Mechatronics	1-0-4	75	3	Practical
5.	Program Elective	Practicum	1030235545	Mechanical Engineering	1-0-4	75	3	Practical
6.	Program Elective	Practicum	1030235546	Estimation, Standards and Regulations	1-0-4	75	3	Practical
7.	Program Elective	Practicum	1030235547	Inter discipline course #	1-0-4	75	3	Practical
# Courses from other programmes with the same credit can be considered after proper approval from DOTE Exam Section.								

SEMESTER - VI

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Theory	600023611x / 103023611x	Elective - 2 (Pathway)	3-0-0	45	3	Theory
2.	Program Elective	Practicum	103023623x	Elective - 3 (Specialization)	2-0-2	60	3	Theory
3.	Industrial Training / Project	Project / Internship	1030236351 / 1030236353 / 1030236374	Internship / Fellowship / In-house Project	-	540	12	Project
Test & Revisions					-	20	-	-
				Total	-	**665**	**18**	-

Note:

1. *For all semesters, the type of End Semester examination for practicum subjects is based on the higher credits towards the theory or practical component of the respective course.*
2. *Some of the audit courses are non-credited but compulsory courses that are a part of the program initiative and the implementation process has to be recorded.*
3. *1 Credit for Projects is equivalent to 45 periods for projects/internships/fellowship*
4. *Electives 3 & 4 are considered as Open Elective, providing the option for students to take courses from other departments also if suitable with approval from the Head of the Institution.*

Elective - 2 (Pathway):

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Elective | Higher Education	Theory	6000236111	Advanced Engineering Mathematics	3-0-0	45	3	Theory
2.	Elective | Entrepreneurship	Theory	6000236112	Entrepreneurship	3-0-0	45	3	Theory
3.	Elective | Technocrats	Theory	6000236113	Project Management	3-0-0	45	3	Theory
4.	Elective | Technocrats	Theory	6000236114	Finance Fundamentals	3-0-0	45	3	Theory
5.	Elective | Technocrats	Theory	1030236115	Industrial Management And Safety	3-0-0	45	3	Theory
6.	Elective | Technocrats	Theory	1030236116	Battery Management System	3-0-0	45	3	Theory
7.	Elective | Technocrats	Theory	1030236117	Industrial Automation	3-0-0	45	3	Theory
8.	Elective | Technocrats	Theory		Online Elective Courses $	3-0-0	45	3	Theory
$ Online courses with the same credit available in AICTE, NPTEL and reputed Institutions with the proper evaluation system and certification can be considered after proper approval from DOTE Exam Section								

Elective - 3 (Specialization):

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Practicum	1030236231	HVAC (R & AC)	2-0-2	60	3	Theory
2.	Program Elective	Practicum	1030236232	PCB Design and Assembly	2-0-2	60	3	Theory
3.	Program Elective	Practicum	1030236233	Electronics Product Design	2-0-2	60	3	Theory
4.	Program Elective	Practicum	1030236234	Renewable Energy Systems	2-0-2	60	3	Theory
5.	Program Elective	Practicum	1030236235	Energy Conservation and Auditing	2-0-2	60	3	Theory
6.	Program Elective	Practicum	1030236236	Electrical Drives and Controls	2-0-2	60	3	Theory

2030 Diploma in Electrical and Electronics Engineering

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PO3 : Design/ development of solutions: Design solutions for well-defined technical problems and assist with thedesign of systems components or processes to meet specified needs.

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GOVERNMENT OF TAMILNADU

DEPARTMENT OF TECHNICAL EDUCATION

DIPLOMA IN ENGINEERING & TECHNOLOGY

REGULATION 2023

2030 DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (SANDWICH)

CREDIT DISTRIBUTION

Semester	No of Courses	Periods	Credits
Semester I	8	640	20
Semester II	8	625	20
Semester III	8	640	21
Semester IV	2	600	16
Semester V	7	625	19
Semester VI	8	660	22
Semester VII	2	540	14
Total	41	4330	**134**

2030 DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (SANDWICH)
REGULATION 2023

SEMESTER - III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030233110	Electrical Machines I	4-0-0	60	4	Theory
2.	Program Core	Theory	1030233210	Electrical Circuit Theory	4-0-0	60	4	Theory
3.	Program Core	Practicum	1030233340	Sensors And Measurement	1-0-4	75	3	Practical
4.	Program Core	Practicum	1030233440	Analog And Digital Electronics	1-0-4	75	3	Practical
5.	Engineering Science	Practicum	1030233540	Programming in C	1-0-2	45	2	Practical
6.	Program Core	Practical/Lab	1030233620	Electrical Machines I Practical	0-0-4	60	2	Practical
7.	Open Elective	Advanced Skill Certification	1030233760	Advanced Skills Certification - 3	0-0-4	60	2	NA
8.	Humanities & Social Science	Integrated Learning Experience	1030233880	Growth Lab	-	30	0	NA
9.	Audit Course	Integrated Learning Experience	1030233881	Induction Program II	-	16	0	-
10.	Audit Course	Integrated Learning Experience	1030233882	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11.	Audit Course	Integrated Learning Experience	1030233883	Shop floor Immersion	-	8	0	-
12.	Audit Course	Integrated Learning Experience	1030233884	Student-Led Initiative	-	22	0	-
13.	Audit Course	Integrated Learning Experience	1030233885	Emerging Technology Seminars	-	8	0	-
14.	Audit Course	Integrated Learning Experience	1030233886	Health & Wellness	0-0-2	30	1	-
Test & Revisions (60) + Library (15)					-	75	-	-
				Total	-	**640**	**21**	-

SEMESTER - IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030234210	Generation, Transmission And Distribution	4-0-0	60	4	Theory
2.	Project / Internship	Project/Internship	2030234274	Industrial Training	0-0-12	540	12	Project
				Total	-	**600**	**16**	-

SEMESTER - V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030234110	Electrical Machines II	4-0-0	60	4	Theory
2.	Program Core	Practicum	1030234340	Microcontroller And Embedded Systems	1-0-4	75	3	Practical
3.	Program Core	Theory	1030235210	Electric Vehicle Technology	3-0-0	45	3	Theory
4.	Program Core	Practicum	1030234540	Servicing of Electrical Appliances	1-0-2	45	2	Practical
5.	Program Core	Practical/Lab	1030234620	Electrical Machines II Practical	0-0-4	60	2	Practical
6.	Program Elective	Practicum	103023554x	Elective -1	1-0-4	75	3	Practical
7.	Open Elective	Advanced Skill Certification	1030234760	Advanced Skills Certification - 4	0-0-4	60	2	NA
8.	Audit Course	Integrated Learning Experience	1030234882	I&E/ Club Activity/ Community Initiatives	-	30	0	NA
9.	Audit Course	Integrated Learning Experience	1030234883	Shop floor Immersion	-	8	0	-
10.	Audit Course	Integrated Learning Experience	1030234884	Student-Led Initiative	-	24	0	-
11.	Audit Course	Integrated Learning Experience	1030234885	Emerging Technology Seminars	-	8	0	-
12.	Audit Course	Integrated Learning Experience	1030234886	Health & Wellness	-	30	0	-
13.	Audit Course	Integrated Learning Experience	1030234887	Special Interest Groups (Placement Training)	-	30	0	-
Test & Revisions (60) + Library (15)					-	75	-	-
				Total	-	**625**	**19**	-

Elective - 1:

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Practicum	1030235541	IoT And Application	1-0-4	75	3	Practical
2.	Program Elective	Practicum	1030235542	Computer Hardware And Networking	1-0-4	75	3	Practical
3.	Program Elective	Practicum	1030235543	Control of Electrical Machines	1-0-4	75	3	Practical
4.	Program Elective	Practicum	1030235544	Auto Mechatronics	1-0-4	75	3	Practical
5.	Program Elective	Practicum	1030235545	Mechanical Engineering	1-0-4	75	3	Practical
6.	Program Elective	Practicum	1030235546	Estimation, Standards and Regulations	1-0-4	75	3	Practical
7.	Program Elective	Practicum	1030235547	Inter discipline course #	1-0-4	75	3	Practical
# Courses from other programmes with the same credit can be considered after proper approval from DOTE Exam Section.								

SEMESTER - VI

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030235110	Power System Protection And Utilization	3-0-0	45	3	Theory
2.	Program Core	Practicum	1030235340	Power Electronics	1-0-4	75	3	Practical
3.	Program Core	Practicum	1030235440	PLC And Automation	1-0-4	75	3	Practical
4.	Program Core	Practicum	1030234440	Electrical CAD Design	1-0-4	75	3	Practical
5.	Humanities & Social Science	Practicum	1030235654	Innovation and Start-ups	1-0-2	45	2	Project
6.	Program Elective	Theory	600023611x / 103023611x	Electives-2 (Pathway)	3-0-0	45	3	Theory
7.	Program Elective	Practicum	103023623x	Elective-3 (Specialization)	2-0-2	60	3	Theory
8.	Open Elective	Advanced Skill Certification	1030235860	Advanced Skills Certification - 5	0-0-4	60	2	NA
9.	Audit Course	Integrated Learning Experience	1030235981	Induction program III	-	40	0	-
10.	Audit Course	Integrated Learning Experience	1030235984	Student-Led Initiative	-	30	0	-
11.	Audit Course	Integrated Learning Experience	1030235986	Health & Wellness	-	30	0	-
12.	Audit Course	Integrated Learning Experience	1030235987	Special Interest Groups (Placement Training)	-	40	0	-
Test & Revisions (40)					-	40	0	-
				Total	-	660	22	-

** Internship shall be offered in the summer break between 4th and 5th semester followed by a review and award of credits in the 5th semester*

Elective - 2 (Pathway):

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Elective | Higher Education	Theory	6000236111	Advanced Engineering Mathematics	3-0-0	45	3	Theory
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Elective - 3 (Specialization):

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Practicum	1030236231	HVAC (R & AC)	2-0-2	60	3	Theory
2.	Program Elective	Practicum	1030236232	PCB Design and Assembly	2-0-2	60	3	Theory
3.	Program Elective	Practicum	1030236233	Electronics Product Design	2-0-2	60	3	Theory
4.	Program Elective	Practicum	1030236234	Renewable Energy Systems	2-0-2	60	3	Theory
5.	Program Elective	Practicum	1030236235	Energy Conservation and Auditing	2-0-2	60	3	Theory
6.	Program Elective	Practicum	1030236236	Electrical Drives and Controls	2-0-2	60	3	Theory

SEMESTER - VII

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Project / Internship	Project/Internship	2030237274	Industrial Training* [Summer Vacation - 90 Hours]	-	-	2	Project
2.	Industrial Training / Project	Project / Internship	1030236351 / 1030236353 / 1030236374	Internship / Fellowship / In-house Project	-	540	12	Project
				Total	-	540	14	-

Note:

1. *For all semesters, the type of End Semester examination for practicum subjects is based on the higher credits towards the theory or practical component of the respective course.*
2. *Some of the audit courses are non-credited but compulsory courses that are a part of the program initiative and the implementation process has to be recorded.*
3. *1 Credit for Projects is equivalent to 45 periods for projects/internships/fellowship*
4. *Electives 3 & 4 are considered as Open Elective, providing the option for students to take courses from other departments also if suitable with approval from the Head of the Institution.*

3030 Diploma in Electrical and Electronics Engineering

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GOVERNMENT OF TAMILNADU

DEPARTMENT OF TECHNICAL EDUCATION

DIPLOMA IN ENGINEERING & TECHNOLOGY

REGULATION 2023

3030 DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (PART TIME)

CREDIT DISTRIBUTION

Semester	No of Courses	Periods	Credits
Semester I	6	300	15
Semester II	6	300	15
Semester III	6	300	14
Semester IV	5	330	14
Semester V	5	315	15
Semester VI	5	300	13
Semester VII	5	315	16
Semester VIII	2	645	18
Total	41	2805	**120**

SEMESTER – III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030233210	Electrical Circuit Theory	4-0-0	60	4	Theory
2.	Basic Science	Practicum	1000232541	Applied Physics – II	1-0-2	45	2	Practical
3.	Basic Science	Practicum	1000232641	Applied Chemistry - II	1-0-2	45	2	Practical
4.	Basic Science	Practicum	1000232740	Basic Engineering Practices	1-0-2	45	2	Practical
5.	Engineering Science	Practicum	1000232320	Drafting Practices - 2	0-0-4	60	2	Practical
6.	Open Elective	Advanced Skill Certification	1000232860	Advanced Skills Certification - 2	1-0-2	45	2	NA
				Total	-	**300**	**14**	-

SEMESTER - IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030233110	Electrical Machines I	4-0-0	60	4	Theory
2.	Program Core	Practicum	1030233440	Analog And Digital Electronics	1-0-4	75	3	Practical
3.	Program Core	Practical/Lab	1030233620	Electrical Machines I Practical	0-0-4	60	2	Practical
4.	Engineering Science	Practicum	1030233540	Programming in C	1-0-2	45	2	Practical
5.	Open Elective	Advanced Skill Certification	1030233760	Advanced Skill Certification – 3	0-0-4	60	2	NA
6.	Humanities and Social Science	Integrated Learning	1030233886	Health & Wellness	0-0-2	30	1	NA
				Total	-	**330**	**14**	-

SEMESTER - V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030234110	Electrical Machines II	4-0-0	60	4	Theory
2.	Program Core	Theory	1030234210	Generation, Transmission And Distribution	4-0-0	60	4	Theory
3.	Program Core	Practicum	1030233340	Sensors And Measurement	1-0-4	75	3	Practical
4.	Program Core	Practical/Lab	1030234620	Electrical Machines II Practical	0-0-4	60	2	Practical
5.	Open Elective	Advanced Skill Certification	1030234760	Advanced Skill Certification – 4	0-0-4	60	2	NA
				Total	-	**315**	**15**	-

SEMESTER - VI

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030235210	Electric Vehicle Technology	3-0-0	45	3	Theory
2.	Program Core	Practicum	1030234340	Microcontroller And Embedded Systems	1-0-4	75	3	Practical
3.	Program Core	Practicum	1030234540	Servicing of Electrical Appliances	1-0-2	45	2	Practical
4..	Program Elective	Practicum	103023554x	Elective -1	1-0-4	75	3	Practical
5.	Open Elective	Advanced Skill Certification	1030235760	Advanced Skill Certification – 5	0-0-4	60	2	NA
				Total	-	**300**	**13**	-

SEMESTER - VII

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Core	Theory	1030235110	Power System Protection And Utilization	3-0-0	45	3	Theory
2.	Program Core	Practicum	1030234440	Electrical CAD Design	1-0-4	75	3	Practical
3.	Program Core	Practicum	1030235340	Power Electronics	1-0-4	75	3	Practical
4.	Program Core	Practicum	1030235440	PLC And Automation	1-0-4	75	3	Practical
5.	Humanities & Social Science	Practicum	1030235654	Innovation and Start-ups	1-0-2	45	2	Project
6.	Project/Internship	Project/Internship	1030235773	Industrial Training* [Summer Vacation - 90 Hours	-	-	2	Project
				Total	-	**315**	**16**	-

** Internship shall be offered in the summer break between 6th and 7th semester followed by a review and award of credits in the 7th semester*

SEMESTER – VIII

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Theory	600023611x / 103023611x	Electives-2 (Pathway)	3-0-0	45	3	Theory
2.	Program Elective	Practicum	103023623x	Elective-3 (Specialization)	2-0-2	60	3	Theory
3.	Industrial Training / Project	Project / Internship	1030236351 / 1030236353 / 1030236374	Internship / Fellowship / In-house Project	-	540	12	Project
				Total	-	**645**	**18**	-

Note:

1. *For all semesters, the type of End Semester examination for practicum subjects is based on the higher credits towards the theory or practical component of the respective course.*
2. *Some of the audit courses are non-credited but compulsory courses that are a part of the program initiative and the implementation process has to be recorded.*
3. *1 Credit for Projects is equivalent to 45 periods for projects/internships/fellowship*
4. *Electives 3 & 4 are considered as Open Elective, providing the option for students to take courses from other departments also if suitable with approval from the Head of the Institution.*

Elective - 1:

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Practicum	1030235541	IoT And Application	1-0-4	75	3	Practical
2.	Program Elective	Practicum	1030235542	Computer Hardware And Networking	1-0-4	75	3	Practical
3.	Program Elective	Practicum	1030235543	Control of Electrical Machines	1-0-4	75	3	Practical
4.	Program Elective	Practicum	1030235544	Auto Mechatronics	1-0-4	75	3	Practical
5.	Program Elective	Practicum	1030235545	Mechanical Engineering	1-0-4	75	3	Practical
6.	Program Elective	Practicum	1030235546	Estimation, Standards and Regulations	1-0-4	75	3	Practical
7.	Program Elective	Practicum	1030235547	Inter discipline course #	1-0-4	75	3	Practical

 # Courses from other programmes with the same credit can be considered after proper approval from DOTE Exam Section.

Elective - 2 (Pathway):

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Elective | Higher Education	Theory	6000236111	Advanced Engineering Mathematics	3-0-0	45	3	Theory
2.	Elective | Entrepreneurship	Theory	6000236112	Entrepreneurship	3-0-0	45	3	Theory
3.	Elective | Technocrats	Theory	6000236113	Project Management	3-0-0	45	3	Theory
4.	Elective | Technocrats	Theory	6000236114	Finance Fundamentals	3-0-0	45	3	Theory
5.	Elective | Technocrats	Theory	1030236115	Industrial Management And Safety	3-0-0	45	3	Theory
6.	Elective | Technocrats	Theory	1030236116	Battery Management System	3-0-0	45	3	Theory
7.	Elective | Technocrats	Theory	1030236117	Industrial Automation	3-0-0	45	3	Theory
8.	Elective | Technocrats	Theory		Online Elective Courses $	3-0-0	45	3	Theory

$ Online courses with the same credit available in AICTE, NPTEL and reputed Institutions with the proper evaluation system and certification can be considered after proper approval from DOTE Exam Section

Elective - 3 (Specialization):

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1.	Program Elective	Practicum	1030236231	HVAC (R & AC)	2-0-2	60	3	Theory
2.	Program Elective	Practicum	1030236232	PCB Design and Assembly	2-0-2	60	3	Theory
3.	Program Elective	Practicum	1030236233	Electronics Product Design	2-0-2	60	3	Theory
4.	Program Elective	Practicum	1030236234	Renewable Energy Systems	2-0-2	60	3	Theory
5.	Program Elective	Practicum	1030236235	Energy Conservation and Auditing	2-0-2	60	3	Theory
6.	Program Elective	Practicum	1030236236	Electrical Drives and Controls	2-0-2	60	3	Theory

Diploma in Electrical and Electronics Engineering

III SEMESTER SYLLABUS

1030233110	ELECTRICAL MACHINES I	L	T	P	C
THEORY		4	0	0	4

Introduction:

A solid foundation in Electrical Engineering is crucial for all engineers. It's important for them to have a deep understanding of the basic principles, construction, and operation of D.C Machines, Transformers, and specialized machines. For students to develop the required psychomotor skills in this field, it's essential that they not only grasp the concepts but also apply them effectively.

Course Objectives:

The objective of this course is to enable the student to

- Comprehend operation, types and characteristics of DC Generator.
- Comprehend operation, types, characteristics and speed control of DC Motor.
- Learn the operation, types, EMF Equation, phasor diagrams, efficiency and parallel operation of single phase transformer.
- Study parallel operation, cooling & tap changers of transformer.
- Emphasize preventive and breakdown maintenance, resolve sparking, maintain transformer oil and understand earthing.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand the significance and operation of DC Generator.

CO2 : Understand the significance and operation of DC Motor.

CO3 : Describe Principles and applications of single-phase transformer

CO4 : Describe the construction of three-phase transformer and its accessories.

CO5 : Apply maintenance strategies for electrical equipment.

Pre-requisites:

- Basics of Science and Basic algebra.
- Basic Electrical Engineering.

1030233110	ELECTRICAL MACHINES I	L	T	P	C
THEORY		4	0	0	4

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	-	-	2
CO2	3	2	1	1	-	-	2
CO3	3	2	1	1	-	-	2
CO4	3	2	-	1	-	-	2
CO5	2	2	-	2	2	-	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030233110	ELECTRICAL MACHINES I	L	T	P	C
THEORY		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6^{th} Week	12^{th} Week	$13\text{-}14^{th}$ Week	16^{th} Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
    - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
    - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
    - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

<u>Instructions to the Question Setters:</u>

- Exam Duration: 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030233110	ELECTRICAL MACHINES I	L	T	P	C
THEORY		4	0	0	4

Theory Portion :		
UNIT I	**DC GENERATORS**	Period
	Basics of Electromagnetism - Overview of DC Generator - Importance of DC generators in power generation and various industries - Types of DC generators - EMF equation - Simple Problems - Internal and External characteristics – Applications - Process of building up of EMF - Critical field resistance - Causes of failure to build up voltage and remedies - Analysis of armature reaction effects - Commutation process – methods of improving commutation.	12
UNIT II	**DC MOTORS**	Period
	Overview of DC Motors - Significance of DC Motors in various industries and automation - Types of DC Motors – Torque equation – Simple problems - Load characteristics – Torque - Speed characteristics – Applications - Necessity of starters - 3 point and 4 point starters - Speed Control of DC Motors – Losses, Efficiency and regulation of DC Motors - simple problems – Special DC Machines: BLDC Motor, Servomotor, PMDC Motor, Stepper motor.	12
UNIT III	**SINGLE PHASE TRANSFORMERS**	Period
	Introduction to Transformers - Transformer Ratings - Applications – EMF Equation – Problems – Ideal Transformer - No-load and Load Phasor Diagrams at Varying Power Factors - Determination of equivalent circuit constants - Voltage Regulation, Losses and Efficiency - simple problems –Condition for maximum efficiency – All day efficiency - problems- Parallel operation of single-phase Transformer – Auto Transformer – Comparison between two winding transformer and Auto transformer.	12

1030233110	ELECTRICAL MACHINES I	L	T	P	C
THEORY		4	0	0	4

UNIT IV	THREE PHASE TRANSFORMER	Period
Three Phase Transformer – Construction and Types of connections of transformer - Parallel operation and grouping of three phase transformers- Cooling of transformers – Various cooling arrangements – Transformer accessories: Conservator, Breather, Explosion vent, Buchholz relay –ON load and OFF load tap changer.		12
UNIT V	**MAINTENANCE OF DC MACHINES AND TRANSFORMERS**	Period
Importance of Maintenance - Preventive and Breakdown Maintenance – Causes of Sparking in Commutator – Defects in Commutator and Remedies – Resurfacing of Commutator and Brushes - Defects in DC Armature winding – Maintenance of Transformer Oil – Transformer oil tester – Acidity test, BDV test – Earthing – Measurement of earth resistance.		12
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Mini project that shall be an extension of any practical lab exercise to real-world application

Text and Reference Books:

1. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology Volume - II (AC and DC Machines), Multicolour Edition, S. Chand & Co., 2005
2. V.K. Mehta & Rohit Mehta, Principles of Electrical Machines, Second Edition, S. Chand & Co.,2019
3. S. K. Bhattacharya, Electrical Machines, Third Edition, McGraw Hill Education, 2008.
4. Ashfaq Husain, Haroon Ashfaq, Electric Machines, Third Edition, Dhanpat Rai & Co. (P) Ltd., 2016.

1030233110	ELECTRICAL MACHINES I	L	T	P	C
THEORY		4	0	0	4

Web-based/Online Resources:

- NPTEL (Website): The National Programme on Technology Enhanced Learning (NPTEL) offers free online courses on Electrical Machines and other Electrical Engineering topics. NPTEL Electrical Engineering.
- MIT Open Course Ware (OCW) Electrical Engineering and Computer Science - Provides free course materials for electrical engineering topics, including electrical machines.
- Khan Academy - Offers tutorials on basic electrical engineering concepts that can reinforce understanding of electromagnetism and circuit analysis.
- IEEE Xplore Digital Library - For advanced research articles and materials on specific electrical machines and their applications.

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1030233210	ELECTRICAL CIRCUIT THEORY	L	T	P	C
THEORY		4	0	0	4

Introduction:

Electrical circuits are very important to all engineering disciplines either because there are electric circuits in those disciplines or because the underlying physical ideas are easily translated to other disciplines. The two most important laws in circuit analysis are the two Kirchhoff's Laws which are just another form of the conservation laws of physics. These laws are ALWAYS valid in every situation. Circuit theory is the cornerstone of electrical engineering, providing the rules and methods for analyzing electrical circuits. Electric circuit theory is one of the most vital aspects of electrical engineering.

Course Objectives:

The objective of this course is to enable the student to

- Maintain electrical systems applying AC and DC circuit fundamentals
- Impart knowledge on solving circuit equations using network theorems
- Learn the concept of single phase AC Series Circuits for different load condition.
- Learn the phenomenon of single phase AC Parallel circuit and resonance circuits.
- Introduce Phase diagrams and analysis of three phase circuit.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Apply principles of circuit analysis to solve electric circuits.

CO2 : Apply network theorems to solve electric circuits.

CO3 : Solve the problems related to single phase A.C Series circuits.

CO4 : Solve the problems related to single phase A.C Parallel circuits and Resonance circuits.

CO5 : Solve the problems related to three phase circuits.

Pre-requisites: Knowledge of Mathematics.

1030233210	ELECTRICAL CIRCUIT THEORY	L	T	P	C
THEORY		4	0	0	4

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	-	-	-	3
CO2	3	2	3	-	-	-	3
CO3	3	3	3	-	-	-	3
CO4	3	3	2	-	-	-	3
CO5	2	2	2	-	-	-	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030233210	ELECTRICAL CIRCUIT THEORY	L	T	P	C
THEORY		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6^{th} Week	12^{th} Week	$13\text{-}14^{th}$ Week	16^{th} Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030233210	ELECTRICAL CIRCUIT THEORY	L	T	P	C
THEORY		4	0	0	4

Theory Portion :		
UNIT I	**BASIC CIRCUITS ANALYSIS**	Period
Resistive elements - Ohm's Law - Kirchhoff's laws - Resistors in series parallel circuits - Source transformation - Star/delta and delta/star transformation - Mesh Analysis - Node Analysis - Problems on all the above topics.		12
UNIT II	**NETWORK THEOREMS**	Period
Superposition Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem - Problems on all the above topics.		12
UNIT III	**SINGLE PHASE A.C SERIES CIRCUITS**	Period
Sinusoidal voltage and current – Instantaneous, peak, average and effective values – Form Factor - Peak factor - Pure resistive, inductive and capacitive circuits – RL, RC, and RLC series circuits – Impedance – Phase angle – Phasor diagram – Power and Power factor – Power triangle – Apparent power – Active Power - Reactive power - Problems using RL, RC, and RLC series circuits.		12
UNIT IV	**SINGLE PHASE A.C PARALLEL CIRCUITS & RESONANCE**	Period
J Notations – Rectangular and polar coordinates - Parallel circuits (two branches only) – Conductance - Susceptance – Admittance - Problems using two branch parallel circuits. Series Resonance: Effects of varying inductance and capacitance in series RLC circuit – Selectivity – 'Q' factor - Resonance Frequency – Bandwidth – Half power frequencies- Problems on all the above topics. Parallel Resonance : Two branch parallel circuits, Q Factor – Resonance Frequency – Band width – problems on all the above topics.		12

UNIT V	THREE PHASE CIRCUITS	Period
Significance of 3 phase circuits – Star, Delta connections – Phase sequence – Balanced load – Relation between voltages, currents of line and phase values in star and delta connection – Problems in balanced loads of star and delta connections – Measurement of 3 phase power using two wattmeter method (Derivation and Problems) - Star and Delta connected unbalanced loads (No problems) – Symmetrical components (No problems).		12
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Prepare power point presentation on source transformation, star delta transformation, mesh and nodal analysis and give presentation in the class room.

- Select suitable components for the given circuit and prepare the same on bread board to verify the following theorems practically and theoretically: Superposition theorem, thevenin's theorem, maximum power transfer theorem and Norton theorem.

- Design different kinds of circuits that you will study in your class and assemble them using the relevant components, for example:
  - Circuit to measure the value of an unknown resistance using a meter bridge
  - Circuit to compare e.m.f. of two cells using a potentiometer, etc.

- Measure the voltmeter and ammeter readings for different rheostat settings and verify if the ratio of potential difference across the resistor to the current through it is constant. Modify the circuit using two resistors which may either be connected in series or in parallel.

- Make a study of different battery eliminators, dc sources (cells, batteries) in the laboratories.

		L	T	P	C
1030233210	**ELECTRICAL CIRCUIT THEORY**	L	T	P	C
THEORY		4	0	0	4

Text and Reference Books:

1. Dr. M. Arumugam & N. Premakumaran, Electric Circuit Theory, Fifth Edition, Khanna Publishers, 2017
2. B.L. Theraja, A.K. Theraja, A Text Book of Electrical Technology Volume - I , S Chand & Co., 2014.
3. R.K. Mehta & A.K. Mal, Problems and Solutions of Electrical Circuit Analysis, CBS Publishers, 2015.
4. Rajendra Prasad, Fundamentals of Electrical Engineering, Third Edition, PHI Learning Private Limited, 2014.

Web-based/Online Resources:

- II Year diploma level book as per aicte model curriculum (based upon outcome based education as per new education policy 2020) available in AICTE website.
- https://ekumbh.aicte-india.org/userdiplomabook.php
- https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic/circuit-elements/v/ee-ideal-sources
- https://onlinecourses.nptel.ac.in/noc20_ee64/preview

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1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

The advancement of science and technology is dependent upon a parallel progress in measurement techniques. Measurement play a significant role in achieving goals and objectives of Engineering because of the feedback information supplied by them. Sensors are needed to measure unknown signals and parameters of an engineering system and its environment. Sensor is a device that when exposed to a physical phenomenon produces a proportional output signal. A diploma holder when employed in automated industrial process controls will be required to know the basics of Sensors and Measurements.

Course Objectives:

The objective of this course is to enable the student to

- Learn the Construction and working of instruments used for Current, Voltage and Resistance Measurements.
- Learn the Construction and working of instruments used for Power and Energy.
- Practice in handling of Earth Tester, Anderson Bridge and Schering Bridge.
- Explain the working of active and passive transducers and their applications.
- Learn the overview of Arduino compatible sensors.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Understand the Terms and characteristics of measuring instruments.
CO2	:	Perform Calibration of Ammeter, Voltmeter and Energy Meter.
CO3	:	Handle Earth tester, Wheatstone, Anderson and Schering bridges.
CO4	:	Experiment with Temperature sensor, Inductive and Capacitive Sensors.
CO5	:	Demonstrate the applications of Arduino compatible sensors.

Pre-requisites:

- Basic Physics
- Basics of Electrical Engineering.

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	3	2	-	1	1
CO2	3	2	3	2	-	1	1
CO3	3	2	3	2	-	1	1
CO4	3	2	3	2	-	1	2
CO5	3	2	3	2	-	1	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 6	Ex. 7 to 12	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7^{th} Week	14^{th} Week	15^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Tabulation / Graph, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	15
C	Connection	10
D	Execution and Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	20
C	Connections	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination* and End Semester Practical Examination.

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**MEASURING INSTRUMENTS**	Period
Definition of Measurement - Definition of True Value, Accuracy, Precision, Error and Error Correction, Instrument Efficiency – Classifications of Analog Instruments (Indicating, Recording and Integrating) – Operating Forces (Deflecting force, Controlling force & Damping force). Construction, Working and Torque Equation of Permanent Magnet Moving Coil Instrument and Moving Iron Instruments (Repulsion and Attraction type) – Extension of Instrument Range using Shunts and Multipliers – CT and PT – Construction and Working of Multimeter, Megger and Earth Tester. Construction and Working of: Single Phase Electro Dynamometer type Wattmeter - Single Phase Energy Meter – Three Phase Energy Meter - Digital Energy Meter – Introduction about Power Factor Meter, Frequency Meter and Phase Sequence Indicator – Block Diagram of CRO.		8

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1	VOLTAGE, CURRENT AND POWER MEASUREMENT IN SINGLE PHASE AC CIRCUIT. Activities to Perform: a) Conduct an experiment to measure voltage, current and power in single phase a.c circuit by using Voltmeter, Ammeter and Wattmeter respectively for different loads. b) Repeat the same experiment by replacing above meters with single Digital Power Monitor. c) Compare and Discuss the observations.	4
2	CALIBRATION OF AMMETER AND VOLTMETER Activities to Perform: i) Conduct an Experiment to calibrate the given Ammeter and Voltmeter with corresponding standard meters. ii) Plot the Error Curve.	4

3.	MEASUREMENT OF CURRENT IN THREE PHASE CIRCUIT BY USING SINGLE AMMETER Activities to Perform: i) Connect single Ammeter in three phase circuit through Ammeter Selector Switch (ASS) and Current Transformers. ii) Measure current in R, Y and B phases by using single Ammeter for balanced and unbalanced load.	4
4.	CALIBRATION OF ENERGY METER Activities to Perform: i) Conduct an Experiment to calibrate the given Three Phase Energy Meter using Wattmeter and Stop Clock. ii) Plot the Error Curve.	4
5	MEASUREMENT OF RESISTANCE USING WHEATSTONE BRIDGE Activities to Perform: i) Discuss the theory of Wheatstone Bridge. ii) Conduct an Experiment to measure the value of armature winding resistance using Whetstone Bridge. iii) Compare the observed value of resistance with theoretical / calculated value.	4
6	MEASUREMENT OF EARTH RESISTANCE BY USING EARTH TESTER. Activities to Perform: i) Discuss the Necessity of maintaining Earth Resistance as Low Value. ii) Discuss the Permissible Earth Resistance Value as per Indian Standard. iii) Conduct an Experiment to measure the Earth Resistance by using Earth Tester.	4

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT II	**SENSORS AND TRANSDUCERS**	Period
	Resistance and Inductance Sensors: Definition of Transducer –Classification of Transducers - Resistive Transducer (Linear and Rotary POTs) – Strain Gauge Load Cell – Construction and Operation of LVDT and RVDT. Temperature Sensors: Thermocouple – Resistance Temperature Detector – Thermostat. Proximity Sensors: Inductive Proximity Sensor – Capacitive Proximity Sensor. Light Sensor: Photodiode – Phototransistor – Photoconductive Cell - Photovoltaic Cells - Bar Code Reader - Optical Shaft Encoder. Overview of Arduino compatible sensors: Ultrasonic Sensor - Moisture Sensor – Current Sensor.	7
Practical Exercises:		
Ex.No	Name of the Experiment	Period
7	MEASUREMENT OF INDUCTANCE USING ANDERSON BRIDGE Activities to Perform: i) Discuss the theory of Anderson Bridge. ii) Conduct an Experiment to measure the value of unknown Inductance using Anderson Bridge. iii) Compare the measured value of inductance with theoretical / calculated value.	4
8	MEASUREMENT OF CAPACITANCE USING SCHERING BRIDGE Activities to Perform: i) Discuss the theory of Schering Bridge. ii) Conduct an Experiment to measure the value of unknown Capacitance using Schering Bridge. iii) Compare the measured value of Capacitance with theoretical / calculated value.	4

9	TEMPERATURE MEASUREMENT Activities to Perform: i) Construct a circuit to measure Temperature of Liquid using Thermostat, Thermocouple and RTD (Any 2). ii) Plot the graphical relationship between input and output parameters.	4
10	BEHAVIOUR OF PROXIMITY SENSORS Activities to Perform: i) Observe the behaviour of Inductive proximity sensor and Capacitive Proximity sensor for different material samples. ii) Interface relay and buzzer with sensors to test the output.	4
11	LVDT Activities to Perform: i) Construct a circuit for Measurement of Linear Displacement using LVDT. ii) Plot the graphical relationship between input and output parameters.	4
12	PERFORMANCE OF ULTRASONIC AND MOISTURE SENSORS Activities to Perform: i) Interface Ultrasonic sensor with Arduino and measure the distance of the object. ii) Interface Moisture sensor with Arduino and measure the moisture content in the soil. iii) Discuss the applications of Ultrasonic sensor and Moisture Sensor.	4
	Required Practical Instructions for all the Experiments	12
	TOTAL PERIODS	**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

1. Activity 1: Submit the assignment of the following: Draw the symbols to represent Nature of Measured Quantity and Number of Measuring Elements, Safety, Position of Use, Accuracy Class and Principle of Operation in Analog Instruments. (Refer Textbook No.1).

2. Activity 2: Four students can be grouped as a batch and practice an additional experiment to interface any one of the Arduino compatible sensors (LM35 Temperature sensor, Force Sensor, Gas Sensor, Current Sensor, Voltage Sensor, Humidity Sensor, Rain Sensor, Acceleration sensor, magnetic sensor, Infrared sensor etc.,) with Arduino and observe the behaviour of sensors.

3. Activity 3: Draw the block diagram of Digital Voltmeter and Explain its construction and Working. Submit this as assignment.

4. Activity 4: Submit the assignment of the following: Derive the expression for measurement of resistance using Wheatstone bridge, measurement of inductance using Anderson Bridge and measurement of capacitance using Schering Bridge.

Text and Reference Books:

1. A.K. Sawhney Puneet Sawhney, A Course in Electrical and Electronics measurements and instrumentation, Dhanpat Rai & Co.,(Pvt) Ltd., 2012.
2. D. Patranabis, Sensors and Transducers, Multicolour Edition, Second Edition, PHI Learning Private Limited., 2013
3. D.V.S. Murty , Transducers and Instrumentation, Second Edition, PHI Learning Pvt Ltd., 2012.

Web-based/Online Resources:

- https://archive.nptel.ac.in/courses/108/108/108108147/
- https://archive.nptel.ac.in/courses/108/105/108105153/

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	MI Voltmeter (0-250V), MI Ammeter (0-5A), ED Wattmeter 300V/5A, Digital Power Monitor 10A, 1KW Load Bank	Each 1 No
2.	MC/MI Voltmeter (0-250V), MC/MI Ammeter (0-5A), Standard Voltmeter (0-250V), Ammeter (0-5A), 1KW Load Bank	Each 1 No
3.	MI Ammeter (0-5A), Ammeter Selector Switch, 10/5A CT for each phase.	Each 1 No
4.	Three Phase Energy Meter 250V/10A, Suitable Wattmeter and Stop Clock	Each 1 No
5.	Wheatstone Bridge	1 No
6.	Earth Tester with necessary connecting leads and rods	1 No
7.	Anderson Bridge	1 No
8.	Schering Bridge	1 No
9.	Temperature Measurement using Thermocouple / Thermistor / RTD Kit (any two)	Each 1 No
10.	Inductive and Capacitive Proximity Sensors, Relay, Buzzer, Suitable Power Supply Unit	Each 1 No
11.	LVDT Trainer Kit	1 No
12.	Arduino Shield, Arduino compatible Ultrasonic Sensor and Moisture sensor, Desktop Computer/Laptop	Each 1 No

1030233340	SENSORS AND MEASUREMENT	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Conduct an experiment to measure voltage, current and power in single phase a.c circuit by using Voltmeter, Ammeter and Wattmeter respectively for different loads.
2. Conduct an Experiment to calibrate the given Ammeter and Voltmeter with corresponding standard meters.
3. Conduct an Experiment to measure current in three phase circuit by using single ammeter.
4. Conduct an Experiment to calibrate the given Three Phase Energy Meter using Wattmeter and Stop Clock.
5. Conduct an Experiment to measure the value of armature winding resistance using Whetstone Bridge.
6. Conduct an Experiment to measure the Earth Resistance by using Earth Tester.
7. Conduct an Experiment to measure the value of unknown Inductance using Anderson Bridge.
8. Conduct an Experiment to measure the value of unknown Capacitance using Schering Bridge.
9. Construct a circuit to measure Temperature of Liquid using Thermostat, Thermocouple and RTD. (Any 2 transducer).
10. Construct a circuit and Observe the behaviour of Inductive proximity sensor and Capacitive Proximity sensor for different material samples.
11. Construct a circuit for Measurement of Linear Displacement using LVDT.
12. Develop and Execute Arduino Program to obtain the performance of Ultrasonic sensor and Moisture Sensors.

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1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

This course on Analog and digital Electronics has been designed primarily as a core course for diploma level students and, as a refresher course for master level students and circuit designers working in industry. It starts with basic circuit components and circuit concepts and then, gradually moves to practical building blocks of analog electronic systems. The discussed circuits can be constructed in a diploma level laboratory class and their measured performance can be easily compared with the analytically predicted performance. It helps to build confidence on theory.

Course Objectives:

The objective of this course is to enable the student to

- Understand the VI Characteristics of basic Semiconductor Devices.
- Learn the features of Operational amplifiers and IC 555 Timers.
- Demonstrate the applications of Op-Amp IC 741.
- Learn the concept of Number System, Logic Gates and Arithmetic Circuits.
- Understand the working of Combinational circuit and Sequential circuits.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Construct DC Power Supply Unit using Rectifier, Filter and Voltage Regulator.
CO2	:	Construct Astable Multivibrator circuit using IC 555.
CO3	:	Develop Amplifier, Summer and Zero crossing detector using Op-Amp IC 741.
CO4	:	Interpret various Number Systems and Logic Gates used in Digital Circuits.
CO5	:	Demonstrate Combinational circuit and Sequential circuits.

Pre-requisites:

- Basic Electrical and Electronics Engineering.

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	-	1	1
CO2	3	2	2	2	-	1	1
CO3	3	2	2	2	-	1	1
CO4	3	2	3	2	-	1	1
CO5	3	2	2	2	-	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 12	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Tabulation / Graph, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	15
C	Connection	10
D	Execution and Output/Result	20
	TOTAL	50
E	Practical Documents (As per the portions)	10
	EXAM MARKS	**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
	TOTAL MARKS		**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	20
C	Connections	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
	TOTAL MARKS	**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**SEMICONDUCTOR DEVICES**	Period
Construction and V-I characteristics of : Diode, Zener Diode, BJT, FET, UJT, SCR, TRIAC, DIAC – Applications - Half Wave Rectifier With & Without filter - Full Wave Rectifier With & Without filter – Zener Diode as Voltage Regulator - Common Emitter, Common Base and Common Collector Configuration of BJT.		4
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Construct the circuit and Obtain the VI Characteristics of PN Junction Diode and Zener Diode.	4
2.	Construct the circuit and Obtain the Input and Output Characteristics of BJT in CE Configuration.	4
3.	Construct the circuit and Obtain the VI Characteristics of FET & UJT.	4
4.	Construct the circuit and Obtain the Input and output Wave forms of Half Wave Rectifier with and without filter.	4
5.	Construct the circuit and Obtain the Input and output Wave forms of Bridge Rectifier with and without filter.	4
Theory Portion:		
UNIT II	**OP-AMP IC 741 and TIMER IC 555**	Period
Operational Amplifiers - Introduction (block diagram approach) - characteristics of ideal and practical op amps - concept of virtual ground – parameters of op amp (listing and definitions) - Symbol and Pin diagram of Op-Amp IC 741. IC 555 Timer – Pin diagram - IC Voltage Regulators - Positive IC Voltage Regulators: 78XX - Negative IC Voltage Regulators: 79XX.		4

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
6.	Construct Inverting Amplifier and Non-Inverting amplifier using Op-amp IC 741 and Test its performance.	4
7.	Construct Summing Amplifier and Difference amplifier using Op-amp IC 741 and Test its performance.	4
8.	Construct Zero Crossing Detector and Voltage Comparator using Op-amp IC 741 and Test its performance.	4
9.	Construct Astable Multivibrator circuit using IC 555 and Test its performance.	4
10.	Test the performance of IC Voltage Regulator Power Supplies using IC 7805, IC 7912.	4
Theory Portion :		
UNIT III	**LOGIC GATES AND COMBINATIONAL CIRCUITS**	Period
Number Systems: Decimal – Binary – Octal – Hexadecimal – BCD – Conversion from one number system to other. Boolean Algebra – Basic laws and Demorgan's Theorems. Logic Gates: Symbol and Truth table of OR Gate, AND Gate, NOT Gate, NAND Gate, NOR Gate and Ex-OR Gate.		4
UNIT IV	**SEQUENTIAL CIRCUITS**	Period
SR, D, JK, T Flip Flops: Symbolic Representations, Truth tables and List of Applications.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
11.	Realization of basic gates using NAND & NOR Gates.	4
12.	Construct Half Adder and Full Adder circuit using Discrete IC's and Test its performance.	4
	Required Practical Instructions for all the Experiments	12
	TOTAL PERIODS	**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

1. Presentation/Seminars by students on any recent technological developments based on the course.
2. Periodic class quizzes to be conducted on a weekly/fortnightly based on the course.
3. Viva Voce to be conducted before conducting each experiment.

Text and Reference Books:

1. V K Mehta, Rohit Mehta, Principles of Electronics, 12th Edition, S. Chand & Co., 2020
2. R.S. Sedha, Applied Electronics, Multicolour Edition, S Chand & Co., 2019
3. Ramakant A. Gayakwad , Op-amps and Linear Integrated Circuits, Revised Fourth Edition, Pearson Education, 2021.
4. Donald Donald P. Leach, Albert Paul Malvino, Goutam Saha, Digital Principles and Applications, Eight Edition, Mc Graw-Hill Education, 2014.

Web-based/Online Resources:

- NPTEL/SWAYAM: Analog: https://nptel.ac.in/courses/117/103/117103063
- https://nptel.ac.in/courses/108/105/108105158
- https://nptel.ac.in/courses/108/102/108102112
- https://nptel.ac.in/courses/108/105/108105113
- NPTEL/SWAYAM: Digital circuits .https://nptel.ac.in/courses/108/105/108105132
- https://nptel.ac.in/courses/117/106/117106086

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	DC Regulated Power Supply: 0 – 30V, 1A	5 Nos
2.	IC Voltage Power Supply: 0 – 5V, 1A & 15-0-15V, 1A	Each 5 Nos
3.	Signal Generator 1 MHZ	4 Nos
4.	Dual Trace CRO / DSO	5 Nos
5.	Digital Trainer	10 Nos
6.	DC Voltmeter (Analog/Digital) – Different Ranges	5 Nos
7.	DC Ammeter (Analog/Digital) – Different Ranges	5 Nos
8.	Desktop Computer	1 No
9.	Discrete Components: PN Junction Diodes, Zener Diode, FET, UJT, BJT, Resistors and Capacitors	As required
10.	Logic Gate ICs : NAND and NOR Gate	As required
11.	IC 741, IC 555 , IC78XX and IC79XX	As required
12.	Flip Flop ICs, Half Adder and Full Adder IC's	As required

1030233440	ANALOG AND DIGITAL ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours — Max. Marks: 100

List of Questions

1. Construct the circuit and Obtain the VI Characteristics of PN Junction Diode and Zener Diode.
2. Construct the circuit and Obtain the Input and Output Characteristics of BJT in CE Configuration.
3. Construct the circuit and Obtain the VI Characteristics of FET & UJT.
4. Construct the circuit and Obtain the Input and output Wave forms of Half Wave Rectifier with and without filter.
5. Construct the circuit and Obtain the Input and output Wave forms of Full Wave Rectifier with and without filter.
6. Construct Inverting Amplifier and Non-Inverting amplifier using Op-amp IC 741 and Test its performance.
7. Construct Summing Amplifier and Difference amplifier using Op-amp IC 741 and Test its performance.
8. Construct Zero Crossing Detector and Voltage Comparator using Op-amp IC 741 and Test its performance.
9. Construct Astable Multivibrator circuit using IC 555 and Test its performance.
10. Construct a circuit to test the performance of IC Voltage Regulator Power Supplies using IC 7805, IC 7912.
11. Construct a circuit for Realization of basic gates using NAND & NOR Gates.
12. Construct Half Adder and Full Adder circuit using Discrete IC's and Test its performance.

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1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

Introduction:

This course is designed to provide students with a comprehensive understanding of the fundamentals of programming. Through a structured curriculum, students will delve into the history of programming languages, master algorithmic thinking, learn to represent logic through flowcharts, and gain practical programming skills using the C language.

Course Objectives:

The objective of this course is to enable the student to

- Learn the concepts of Programming
- Know the basics and the fundamentals of C Language such as variables, data types and control structures.
- Use of Controls Statements and Looping Statements.
- Learn about arranging data in Arrays and String manipulations.
- Gain grasp of programming fundamentals such Ability to design programs using functions and structures.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand about the Programming concepts.

CO2 : Store different data types and variables.

CO3 : Control the program order and repeating sequences of the program.

CO4 : Implement Arrays and Strings in your C program.

CO5 : Apply code reusability with functions and storing different Data types using Structures.

Pre-requisites:

- Digital Skills
- Knowledge on Handling Computer

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	1	-	-	3
CO2	3	1	2	1	-	-	3
CO3	3	3	3	3	-	-	3
CO4	3	3	3	3	-	-	3
CO5	3	3	3	3	-	-	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Program, Printout, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Program	15
C	Execution	10
D	Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Program	20
C	Execution	20
D	Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

Theory Portion :		
UNIT I	**INTRODUCTION TO C PROGRAMMING**	Period
Introduction C - Features of C - Structure of C program – Compiling - Link & run a C program - C character set – Tokens – Constants - Key words - Identifiers and Variables - Data types and storage - Data type Qualifiers - Declaration of Variables - Assigning values to variables.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1	Write and Execute a C program to implement Ohm's Law.	3
2	Write and Execute a C program to calculate total resistance of 3 resistors connected in series and in parallel.	3
Theory Portion :		
UNIT II	**C LANGUAGE BASICS**	Period
DATA TYPES IN C - C Operators - Operators and Associativity - Arithmetic Expression - Evaluation of Expressions - Type Cast Operators - I/O Statements - scanf and printf.		3
Practical Exercises:		
3	Write and Execute a C program to calculate Power using Voltage and Current, Voltage and Resistance, Current and Resistance.	3
4	Write and Execute a C Program to calculate sum and average of 5 numbers.	3
Theory Portion :		
UNIT III	**STATEMENTS**	
Branching: Introduction - Simple if statement - if–else statement - Switch statement - goto statement - Simple programs.		3

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

Practical Exercises:		
5	Write and Execute a C program to Check Largest of Three Numbers.	3
6	Write and Execute a C Program to calculate total capacitance of 3 capacitors connected in series and in parallel using switch case.	3
Theory Portion :		
UNIT IV	**ARRAYS and STRINGS**	Period
Array: Definition – Declaration - Initialization of one dimension array. Strings: Introduction - Declaring and Initializing string variables - Reading strings - Writing strings - String handling functions - strlen() , strcpy() and strrev().		3
Practical Exercises:		
7	Write and Execute a C program to accept 10 numbers and print them.	3
8	Write and Execute a C Program to perform string functions strlen, strcmp and strrev.	3
Theory Portion :		
UNIT V	**FUNCTIONS AND STRUCTURES**	Period
Function Definition: Built-in functions - Math Function - pow() - sqrt() - min() - User defined Function: Declaration - Defining and function call. Structures: Definition - Initialization (Concepts only).		3
Practical Exercises:		
9	Write and Execute a C program to find power and square root using Math Functions.	3
10	Write and Execute a C Program to calculate Electrostatic Force (Coulomb's Law) using function.	3
	TOTAL PERIODS	**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

1. Download and learn the Basic code for Various C Programming.
2. Presentation / Seminar by students on any technological development Programming.
3. Periodic class quizzes conducted on monthly.

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

Text and Reference Books:

1. Herbert Schildt, C: The Complete Reference, Fourth Edition, McGraw Hill Education, 2017.
2. E. Balagurusamy , Programming In ANSI C, Eight Edition, McGraw Hill, 2019.
3. Vinod Sir, Modern C Programming Language Advance, Publisher: Vinod Yadav, 2021.

Web-based/Online Resources:

- https://archive.nptel.ac.in/courses/106/104/106104128/

Equipment / Facilities required to conduct the Practical Course Requirement: (For a Batch of 30 Students)

LIST OF EQUIPMENTS

S.No	LIST OF EQUIPMENTS	QUANTITY REQUIRED
1	Desktop Computer	30 Nos
2	C Compiler	30 Nos
3	5KVA UPS with Battery Backup	1 No

1030233540	PROGRAMMING IN C	L	T	P	C
PRACTICUM		1	0	2	2

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Write and Execute a C program to implement Ohm’s Law.
2. Write and Execute a C program to calculate total resistance of 3 resistors connected in series and in parallel.
3. Write and Execute a C program to calculate Power using Voltage and Current, Voltage and Resistance, Current and Resistance.
4. Write and Execute a C Program to calculate sum and average of 5 numbers.
5. Write and Execute a C program to Check Largest of Three Numbers.
6. Write and Execute a C Program to calculate total capacitance of 3 capacitors connected in series and in parallel using switch case.
7. Write and Execute a C program to accept 10 numbers and print them.
8. Write and Execute a C Program to perform string functions strlen, strcmp and strrev.
9. Write and Execute a C program to find power and square root using Math Functions.
10. Write and Execute a C Program to calculate Electrostatic Force (Coulomb's Law) using function.

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1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Introduction:

To provide students with a comprehensive understanding of various aspects of electrical machines and transformers, including their characteristics, performance evaluation methods, control techniques, and maintenance procedures. This knowledge is essential for engineers working in fields such as power generation, distribution, industrial automation, and electric vehicle technology.

Course Objectives:

The objective of this course is to enable the student to

1. Comprehend the behaviour and characteristics of DC Shunt Generator and DC Series Generator.
2. Perform load tests on DC Shunt motor and DC Series Motor and interpret data.
3. Evaluate the regulation, efficiency, and losses in single-phase and three-phase transformer at various loads.
4. Conduct breakdown and acidity tests on transformer oil and interpret reliability and longevity.
5. Learn the characteristics of stepper motor and servo motor.

Course Outcomes

After successful completion of this course, the students will be able to

CO1	:	Perform Load tests on DC Shunt Generator and DC Series Generator and interpret characteristic curves.
CO2	:	Perform load tests on DC Shunt Motor and DC Series Motor and explore armature and field control methods for speed modulation.
CO3	:	Conduct OC Test, SC Test and Load tests on single-phase transformers to evaluate their performance characteristics.
CO4	:	Perform breakdown test and acidity tests on Transformer oil.
CO5	:	Test the performance of stepper motor and servo motor drive.

Pre-requisites:

- Electrical Machines – I Theory

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	3	-	-	2
CO2	3	2	1	3	-	-	2
CO3	3	2	2	3	-	-	3
CO4	3	2	2	3	-	-	2
CO5	3	2	-	3	1	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers make the learning experience more engaging by introducing innovative and interesting ways of teaching.
- The teachers need to expose the student to material in multiple modes help them learn it faster and retain it longer.
- Theory Lectures: Cover the fundamental principles of electromagnetism, the construction of DC machines, and their working principles.
- Demonstrations: Use models or simulations to demonstrate how DC generators produce electricity and how motors convert electrical energy into mechanical energy.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- Preparation: Before each class, ensure all equipment is functional and safety protocols are in place.

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 6	Ex. 7 to 12	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	15
C	Connection	10
D	Execution and Output/Result	20
TOTAL MARKS		**50**

- **CA 3:** Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Tabulation, Graph, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical Test.

- **CA 4:** All the exercises/experiments should be completed and kept for the Model practical examination. The students shall be permitted to select any one by lot for the test. The model practical examination should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Circuit Diagram	25
C	Connections	25
D	Execution and Output/Result	30
E	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1	No load and Full Load Characteristics of Self Excited DC Shunt Generator.	5
2	Load Characteristics of Self Excited DC Series Generator.	5
3	a. Load Test on DC Shunt Motor and Draw the Performance Curve. b. Predetermination of Efficiency of DC Machines by Swinburne's Test.	5
4	Load Test on DC Series Motor and Draw the Performance Curve	5
5	Speed Control of DC Shunt Motor by a) Armature Control Method b) Field Control Method	5
6	Load Test on Single Phase Transformer.	5
7	Load Test on Three Phase Transformer.	5
8	a. Predetermination of Efficiency and Regulation of Single-Phase Transformer by conducting O.C and S.C Tests. b. Finding the Equivalent Circuit Constants of Single-Phase Transformer by conducting O.C and S.C Tests.	5
9	Parallel Operation of two Single Phase Transformers.	5
10	Breakdown Test to determine the Dielectric Strength of Transformer Oil and Also conduct Acidity Test on Transformer Oil.	5
11	Testing of Stepper motor drive.	5
12	Testing of Servo motor drive.	5
TOTAL PERIOD		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Note: During all practical examinations, sub-division in Q.No 03 & 08 will be treated as separate experiment and separate question.

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Suggested List of Students Activity:

- Engaging in group discussions to delve into the theoretical dimensions of DC generators, motors, transformers, and their operation.
- Utilizing simulation tools such as MATLAB/Simulink for dynamic modeling and analysis, enhancing conceptual visualization and understanding.
- Embarking on research tasks to investigate the latest developments and innovations in DC machinery and transformers, focusing on energy efficiency and advanced materials.
- Presenting lab and project findings to foster knowledge reinforcement and polish communication skills.
- Analyzing industrial case studies to connect theoretical learning with practical applications in real-world scenarios.
- Participating in guest lectures and workshops to gain insights from industry experts and learn about critical diagnostic tests for equipment maintenance
- Encouraging peer teaching and collaborative design projects, aiming at the development of efficient or novel engineering solutions.
- Group Projects: Assign projects to conduct load tests on DC shunt and series motors, encouraging teamwork and problem-solving

Text and Reference Books:

1. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology Volume - II (AC and DC Machines), Multicolour Edition, S. Chand & Co., 2005
2. V.K. Mehta & Rohit Mehta, Principles of Electrical Machines, Second Edition, S. Chand & Co., 2019
3. S. K. Bhattacharya, Electrical Machines, Third Edition, McGraw Hill Education, 2008.
4. Ashfaq Husain, Haroon Ashfaq, Electric Machines, Third Edition, Dhanpat Rai & Co. (P) Ltd., 2016.

Web-based/Online Resources:

- All About Circuits (https://www.allaboutcircuits.com/)
- Electronics Hub (https://www.electronicshub.org/)
- Circuit Digest (https://circuitdigest.com/)
- MIT Open Course Ware - Electrical Engineering and Computer Science (https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/)
- NPTEL - Electrical Engineering (https://nptel.ac.in/course.html)
- IEEE Xplore Digital Library (https://ieeexplore.ieee.org/Xplore/home.jsp)
- Online simulation tools like Circuit Lab (https://www.circuitlab.com/) and Multisim Live (https://www.multisim.com/).

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Equipment / Facilities required to conduct the Practical Course Requirement: (For a Batch of 30 Students)

S.No	LIST OF EQUIPMENTS	QUANTITY REQUIRED
1.	DC Shunt Motor 3/5 KW (or more) with starting and Loading Arrangements	2 Nos
2.	DC Series Motor 3/5 KW (or more) with starting and Loading Arrangements	1 No
3.	DC Shunt Generator 3/5 KW (or more) coupled with Prime Mover	1 No
4.	DC Series Generator 3/5 KW (or more) coupled with Prime Mover	1 No
5.	1 Phase Transformer 1KVA (or more) 220V/110V	3 Nos
6.	3 Phase Transformer 1KVA (or more) 440V/220V	1 No
7.	1 Phase Variac 10 amps	3 Nos
8.	3 Phase Variac 15 amps	2 Nos
9.	Single Phase Resistive Load 1.5KW/3/5 KW, 220V	2 Nos
10.	Three Phase Resistive Load 3KW,415V	2 Nos
11.	Tachometer Digital type	3 Nos
12.	Rheostat – Various ranges 50Ω/5A,100 Ω/5A, 300 Ω/2A, 600 Ω/2A (or equivalent)	4 Nos
13.	AC Ammeter – Various ranges 0-500mA, 0-1/2A, 0-5/10A, 0-10/20A (or equivalent)	8 Nos

14.	DC Ammeter – Various ranges 0-500mA, 0-2A, 0-5A, 0-10A, 0-15/30A (or equivalent)	8 Nos
15.	DC Voltmeter – 0 - 5/10V, 0 - 30V, 0 - 300V	8 Nos
16.	AC Voltmeter – 0 - 75V, 0 - 150V, 0 - 300V, 0 - 600V	8 Nos
17.	Wattmeter – Various ranges LPF 150/300/600V 2.5A/5A,1/2.5A	6 Nos
18.	Wattmeter – Various ranges UPF 75/150/300,5/10A	6 Nos
19.	Wattmeter – Various ranges UPF 150/300/600V 10/20A	6 Nos
20.	Transformer oil BDV Test kit and Acidity Test kit	Each 1 No
21.	DC Stepper Motor drive	1 No
22.	DC Servo Motor drive	1 No

1030233620	ELECTRICAL MACHINES I PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Conduct an Experiment to obtain the No load and Full Load Characteristics of Self Excited DC Shunt Generator.
2. Conduct an Experiment to obtain the Load Characteristics of Self Excited DC Series Generator.
3. Conduct Load Test on DC Shunt Motor and Draw the Performance Curve.
4. Predetermine the Efficiency of DC Machines by Swinburne's Test.
5. Conduct Load Test on DC Series Motor and Draw the Performance Curve.
6. Perform Speed Control of DC Shunt Motor by
   a) Armature Control Method b) Field Control Method
7. Conduct Load Test on Single Phase Transformer.
8. Conduct Load Test on Three Phase Transformer.
9. Predetermine the Efficiency and Regulation of Single-Phase Transformer by conducting O.C and S.C Tests.
10. Find the Equivalent Circuit Constants of Single-Phase Transformer by conducting O.C and S.C Tests.
11. Perform Parallel Operation of two Single Phase Transformers.
12. Perform Breakdown Test to determine the Dielectric Strength of Transformer Oil and Acidity Test on Transformer Oil.
13. Connect Stepper motor with suitable drive / driver circuit and test its operation.
14. Connect Servo Motor with suitable drive / driver circuit and test its operation.

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Regulation 2023

Diploma in Electrical and Electronics Engineering

IV SEMESTER SYLLABUS

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

Introduction:

The Electrical Machines - II course is designed to build upon the foundational knowledge gained in Electrical Machines - I, propelling students into the more advanced aspects of electrical machinery. This syllabus is crafted to deepen understanding and enhance skills in the operation, and application of alternators, induction motors, and a variety of specialized AC machines. Through a blend of theoretical concepts and practical insights, the course aims to equip students with a robust understanding of the principles behind alternating current (AC) machines and their critical role in the modern electrical engineering landscape.

Course Objectives:

The objective of this course is to enable the student to:

- Grasp alternator principles, types, construction, windings, cooling, excitation, and EMF equation's impact on performance.

- Explore load analysis, voltage regulation, testing, parallel operation, synchronization, and load sharing in alternators.

- Explore rotating magnetic fields, operation, types, torque-speed characteristics and maintenance of three phase induction motor.

- Examine single-phase motor types, starting methods, principles, and applications. Understand induction motor maintenance and protection practices.

- Understand synchronous motor principles, effects of excitation changes, unique behaviours, applications, and comparative analysis with induction motors. Explore special AC Machines.

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand alternator principles, construction, types, EMF equation, and applications.

CO2 : Achieve expertise in voltage regulation, testing, load analysis, and synchronization of alternator.

CO3 : Investigate rotating magnetic fields, induction motor principles, construction, characteristics, starting and speed control methods.

CO4 : Examine single-phase motor types, maintenance practices, and BIS guidelines.

CO5 : Explore synchronous motor principles, behaviours, applications, and special AC Machines.

Pre-requisites:

- Electrical Circuit Theory
- Electrical Machines - I
- Electrical Machines - I Practical.

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	-	-	1	-	3
CO2	3	3	-	2	-	-	3
CO3	3	3	-	3	2	-	3
CO4	3	2	-	2	2	-	3
CO5	3	2	-	2	2	2	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.

- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.

- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.

- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.

- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.

- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

Theory Portion:		
UNIT I	**ALTERNATOR PRINCIPLE AND CONSTRUCTION**	Period
	Basic Principle of Alternators – Stationary Armature Rotating Field – Advantages of Rotating Field – Construction details of Alternator – Types of Alternators – Salient Pole Rotor – Cylindrical Type Rotor – Comparison of Salient pole and Cylindrical pole Alternator – Single layer and Double layer Windings – Full Pitched and Short Pitched Windings – Effect of Distribution Factor and Pitch Factor (No derivation) – EMF Equation – Relation between Frequency, Speed and Number of Poles – Problems – Cooling of Alternators (Methods only) – Excitation and Exciters.	13
UNIT II	**ALTERNATOR PERFORMANCE AND TESTING**	Period
	Load Characteristics of Alternators – Reason for Change in Terminal Voltage – Armature Reaction for various Power Factor Loads – Effective Resistance – Leakage Reactance – Synchronous Reactance - Synchronous Impedance – Voltage Regulation – Determination of Voltage Regulation of Alternator by Direct Load Test method – Predetermination of Regulation of Alternator by Indirect Method (EMF, MMF, and ZPF) (short notes only) – Necessity and conditions for Parallel Operation of Alternators – Synchronizing of Alternators by Dark Lamp Method, Bright Lamp Method, Dark – Bright Lamp Method and Synchroscope Method – Synchronizing Current - Synchronizing Power and Synchronizing Torque – Load Sharing of Alternators – Infinite Bus Bar.	14

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

UNIT III	THREE PHASE INDUCTION MOTOR	Period
Concept of Rotating Magnetic Field (Short notes only) – Principle of Operation of Three Phase Induction Motors – Slip and Slip Frequency – Construction of Squirrel cage and Slip Ring Induction motor – Comparison between Cage and Slip Ring Induction Motors – Expression for Torque in Synchronous Watts – Slip-Torque Characteristics – Stable and Unstable Region – Power Stages – Determination of Maximum Torque – Speed Control of Induction Motors – Starters of Induction Motors – Direct Online Starter and its merits for Cage Motors – Star Delta Starter – Auto Transformer Starter – Rotor Resistance Starter – Cogging – Crawling in Induction Motor – Double cage Induction Motor - Induction Generator.		13
UNIT IV	**SINGLE PHASE MOTORS AND MAINTENANCE OF INDUCTION MOTORS**	Period
SINGLE PHASE MOTORS: Types of Single Phase Motors – Single Phase Induction Motors – Methods of starting – Construction, Working Principle and Slip Torque Characteristics of Split Phase Motor, Capacitor Motors, Shaded Pole Motor, Repulsion Motor, Universal Motor and Reluctance Motor - Operation of Three Phase Motor with Single Phase Supply. MAINTENANCE OF INDUCTION MOTORS: BIS Publication dealing with the code of Practice of Induction Motors and starters – Classification of Cage motors – Continuous rating and intermittent rating – Various types of enclosures – Selection of Starters for Induction Motor – Common Induction Motor Troubles and their Remedies – Static Balancing – Degreasing – Vacuum Impregnation.		11

1030234110	ELECTRICAL MACHINES – II	L	T	P	C
THEORY		4	0	0	4

UNIT V	SYNCHRONOUS MOTOR AND SPECIAL AC MACHINES	Period
SYNCHRONOUS MOTOR: Principle of Operation – Methods of Starting – Effects of Excitation on Armature Current and Power Factor – V Curve and Inverted V Curve of Synchronous Motor – The Phenomenon of Hunting and Prevention of Hunting by Damper Winding – Comparison between Synchronous Motor and Three Phase Induction Motor – Applications. SPECIAL AC MACHINES: Permanent Magnet Synchronous Motor – Switched Reluctance Motor – Variable Reluctance Motor – AC Servo Motor – Linear Induction Motor.		9
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentations/Seminars: Students present on alternator construction innovations, synchronous motor applications, etc.
- Periodic Quizzes: Weekly quizzes on alternator principles, induction motor characteristics, etc.
- Mini Projects: Develop projects on synchronous motor applications or special AC machine simulations.
- Hands-on Demonstrations: Conduct demonstrations on synchronous motor starting methods, alternator testing procedures.
- Problem-Solving Sessions: Solve problems related to alternator cooling methods, induction motor maintenance issues.
- Group Discussions: Discuss topics like load sharing in alternators, synchronization techniques in class.
- Field Visits: Visit power plants or industrial facilities to observe alternator operation and maintenance practices.
- Lab Exercises: Perform experiments on induction motor speed control methods, single-phase motor starting mechanisms.
- Case Studies: Analyze real-world cases of synchronous motor failures and troubleshooting solutions.

- Industry Interaction: Invite industry experts to share insights on alternator performance testing, induction motor maintenance best practices.
- Regularly revise the core concepts of electromagnetism as they are fundamental to understanding electrical machines.
- Focus on understanding the practical applications and operational principles rather than memorizing equations.
- Engage with practical lab sessions or virtual lab simulations to gain hands-on experience with these machines

Text and Reference Books:

1. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology Volume - II (AC and DC Machines), Multicolour Edition, S. Chand & Co., 2005
2. V.K. Mehta & Rohit Mehta, Principles of Electrical Machines, Second Edition, S. Chand & Co.,2019
3. S. K. Bhattacharya, Electrical Machines, Third Edition, McGraw Hill Education, 2008.
4. Ashfaq Husain, Haroon Ashfaq, Electric Machines, Third Edition, Dhanpat Rai & Co. (P) Ltd., 2016.

Web-based/Online Resources:

- **NPTEL (Website):** The National Programme on Technology Enhanced Learning (NPTEL) offers free online courses on Electrical Machines and other Electrical Engineering topics. NPTEL Electrical Engineering.

- ***YouTube:*** There are numerous educational channels offering tutorials on electrical machines principles and construction, performance analysis, and testing. Channels like Learn Engineering, Engineering Explained, and Electrical Engineering Portal provide valuable insights.

- Course: Courses like "Electric Machines" offered by University of Colorado Boulder cover topics including alternator principles, construction, and performance analysis. They provide video lectures, quizzes, and *assignments.*

- ***MIT Open Courseware***: MIT offers free access to course materials for "Electric Machines" which covers topics such as induction motors, synchronous motors, and special AC machines. Lecture notes, assignments, and exams are available.

- ***IEEE Xplore*** Digital Library: IEEE provides access to numerous research papers, articles, and conference proceedings related to electrical machines. It's a valuable resource for in-depth study and research.

- Khan Academy: Khan Academy offers introductory-level videos and tutorials on electrical engineering topics, including principles of alternators, induction motors, and synchronous motors.

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1030234210	GENERATION , TRANSMISSION AND DISTRIBUTION	L	T	P	C
THEORY		4	0	0	4

Introduction

This course, Generation, Transmission and Distribution, explores into the core components of electrical power systems. Various methods of generating electricity, from traditional hydropower and thermal plants to modern renewable like solar and wind are discussed. Factors influencing power plant location and load management techniques used to optimize power delivery are examined. AC transmission systems, analyzing their components and conductor properties are focused. Students will learn how to perform basic calculations related to overhead transmission lines. The course then explores High Voltage Direct Current (HVDC) transmission and Flexible AC Transmission Systems (FACTS) controllers, highlighting their role in modern power grids. It also covers line insulators and underground cables used for power transmission, before concluding with a detailed look at distribution systems and substations, the final delivery points of electrical power.

Course Objectives:

The objective of this course is to enable the student to

- Understand various power generation methods, site selection factors and load management techniques.
- Analyze AC transmission systems, including components, conductor properties, and overhead line calculations.
- Introduce HVDC transmission principles, converter stations and integration with renewables and FACTS controllers.
- Explain line insulator properties, types, and methods to improve string efficiency. Describe underground cable construction and types.
- Understand distribution system requirements, components and classifications. Identify substation types and key equipment.

1030234210	GENERATION , TRANSMISSION AND DISTRIBUTION	L	T	P	C
THEORY		4	0	0	4

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Describe various generation methods, grid integration and smart grid technologies.

CO2 : Design and analyse overhead transmission lines, line support selection and transmission efficiency for optimal power delivery.

CO3 : Propose solutions for HVDC transmission and FACTS controllers for enhanced power transmission and grid stability.

CO4 : Assess effective insulation systems for power transmission, as well as the construction and classification of underground cables.

CO5 : Analyse electrical distribution systems, including substations, bus bar arrangements and AC distribution networks.

Pre-requisites: Basic Mathematics Skills, Science Fundamental, Technology Awareness, Problem-Solving Aptitude, Curiosity and Interest in Energy Systems.

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	2	-	-	-
CO2	3	2	2	1	-	-	-
CO3	3	2	2	1	-	-	-
CO4	3	2	1	1	-	-	-
CO5	3	3	2	2	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1030234210	GENERATION , TRANSMISSION AND DISTRIBUTION	L	T	P	C
THEORY		4	0	0	4

Instructional Strategy:

This syllabus covers a wide range of topics in power system. Here are some instructional strategies, the staff can use to make the learning process engaging and effective:

1. Active Learning:

- Case Studies: Present real-world scenarios related to power generation or transmission challenges. Students can analyze the situation and propose solutions using the course concepts.
- Group Projects: Divide students into groups to search specific topics like advancements in renewable energy or the impact of smart grids. This fosters collaboration and deeper understanding.
- Problem-Solving Sessions: Dedicate time in class for students to solve problems related to line calculations, load management, or transmission efficiency. This helps them apply theoretical knowledge.
- Role-Playing Activities: Simulate a load dispatching centre or a power plant control room. Students can take on roles and make decisions based on course material.

2. Visualization and Technology:

- Animations and Simulations: Utilize animations to illustrate complex concepts like power plant operation or corona formation.
- Interactive Software: Use software that allows students to simulate transmission line behaviour or power flow analysis.
- Virtual Field Trips: Take students on virtual tours of power plants or substations using online resources or VR technology.
- Short Video Clips: Integrate short educational videos to explain specific topics or provide real-world examples.

3. Varied Assessment Techniques:

- Quizzes and Exams: Use traditional quizzes and exams to assess students' understanding of key concepts and calculations.
- Seminar Presentations: Have students present their seminars on chosen topics, allowing them to showcase their knowledge and communication skills.
- Lab Experiments: Conduct lab experiments related to transmission line properties, insulators, or cable testing.
- Take-Home Assignments: Assign challenging problems or case studies that encourage critical thinking and application of knowledge.

Additional Tips:

- Start with the Big Picture: Begin each unit by outlining the learning objectives and how they connect to the overall course goals.
- Connect Theory to Practice: Emphasize real-world applications of the concepts through case studies, industry examples, or guest lectures from professionals.
- Incorporate Student Feedback: Conduct mid-term surveys or discussions to understand student needs and adjust teaching strategies accordingly.
- Provide Resources and Support: Offer students access to additional resources like reference books and online tutorials for clarification.

1030234210	GENERATION , TRANSMISSION AND DISTRIBUTION	L	T	P	C
THEORY		4	0	0	4

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030234210	GENERATION , TRANSMISSION AND DISTRIBUTION	L	T	P	C
THEORY		4	0	0	4

Theory Portion :		
UNIT I	**GENERATION OF ELECTRICAL POWER**	Period
Methods of Generation: Schematic arrangement and choice of site for Hydel, Thermal, Nuclear power plants - Block Diagram of Diesel, Solar Thermal, Solar Photovoltaic – Solar Cell Technologies – Wind & Pumped storage schemes. Load Management: Grid or Inter connected system – Smart Grid - Load curve - Demand factor - Load factor - Plant Use Factor - Diversity factor – Plant capacity factor – Load Dispatching Centre.		12
UNIT II	**A.C TRANSMISSION**	Period
Typical Layout of A.C. Power supply scheme - Elements of a Transmission Line - Over Head Line - Conductor materials and their properties - Line supports and their properties - Types of supports and their applications - Sag in overhead lines - Calculation of Sag - When the supports are at equal and unequal levels - Simple Problems - Constants of a Transmission line - Transposition of Transmission lines - Skin Effect - Ferranti Effect - Corona Formation - Factors affecting Corona - Classification of O.H. Transmission lines - Voltage regulation and Transmission Efficiency (No Problems).		12
UNIT III	**HVDC TRANSMISSION & FACTS**	Period
H.V.D.C Transmission: Layout Scheme - D.C Link configurations (Mono polar, Bipolar and Homo polar) - HVDC Convertor Station (Schematic diagram only) – Integration of HVDC & Renewable energy into existing AC grids - HVDC Locations in India. FACTS: Definition - Need for FACTS controllers - Types of FACTS controllers - SVS – STATCOM - UPFC (Block diagram explanation only).		12

1030234210	GENERATION , TRANSMISSION AND DISTRIBUTION	L	T	P	C
THEORY		4	0	0	4

UNIT IV	LINE INSULATORS AND UNDERGROUND CABLES	Period
Line Insulators: Properties of Insulators - Materials - Types - Causes of failure of Insulators - Testing of Insulators - Potential Distribution over suspension Insulator string - String Efficiency - Methods of improving string Efficiency - Problems. Underground Cables: Construction of a three core cable - Classification of cables - Cables for three phase service - Construction of Belted cable, Screened cable, Pressure cables - Laying of underground cables.		12
UNIT V	**DISTRIBUTION**	Period
Distribution system - Requirements and parts of Distribution system - Classification - Comparison of different distribution systems (A.C and D.C, Overhead & Underground) - A.C Distribution - Types - Connection schemes of AC Distribution system. Sub stations - Classification of sub stations - Indoor and outdoor S.S - Gas insulated S.S – Layout of 110/11KV Substation and 11KV/400V Distribution Substation - Substation equipments - Bus bar - Types of bus bar arrangements.		12
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

Unit I: Generation of Electrical Power

- Activity 1: Power Plant Visit & Report: Organize a visit to a Thermal/ Hydro/ Solar/Wind power plant. Students can then write a report detailing the types of equipment they observed, Power plant layout, and its role in the power generation system.
- Activity 2: Load Management Challenge: Present students with a real-world load curve data set (available online) and ask them to analyze it. They can calculate factors like demand factor, load factor, and plant capacity factor. Challenge them to propose strategies for load management using concepts like smart grids.

Unit II: A.C. Transmission

- Activity 3: Transmission Line Design Project: Simulate the design of a simple overhead transmission line. Students can use online tools or basic calculations to determine factors like sag and conductor selection based on specific power transmission requirements.
- Activity 4: Transmission Line Case Studies: Present students with case studies of real-world challenges faced in AC transmission, such as Corona effect or Ferranti effect. Ask them to search and propose solutions to mitigate these challenges.

Unit III: HVDC Transmission & FACTS

- Activity 5: HVDC System Modelling: Using simulation software or online tools, allow students to model a simple HVDC transmission system. They can explore the differences between AC and DC transmission and analyze the benefits of HVDC integration with renewable energy sources.
- Activity 6: FACTS Controller Debate: Divide the class into groups and assign each group a different type of FACTS controller (SVC, STATCOM, UPFC). Each group searches and presents the advantages and applications of their assigned controller. Hold a class debate to discuss the most effective FACTS controller for specific scenarios.

Unit IV: Line Insulators and Underground Cables

- Activity 7: Insulator Design Challenge: Challenge students to design an insulator string for a specific voltage level. They should consider factors like material selection, string efficiency, and methods for improvement.
- Activity 8: Underground Cable Exploration: Organize a field trip to a local company involved in underground cable installation. Alternatively, students can search and present on the different types of underground cables, their construction, and laying methods.

Unit V: Distribution

- Activity 9: Distribution System Design Project: Divide students into groups and assign them the task of designing a simple distribution system for a specific area (residential, commercial).

They should consider factors like system type (AC/DC, overhead/underground), connection schemes, and substation equipment selection.

- Activity 10: Substation Visit and Report: Organize a visit to a local substation (with safety precautions). Students can then write a report detailing the types of equipment they observed, substation layout, and its role in the power distribution system.

Text and Reference Books:

1. VK. Mehta, Rohit Mehta, Principles of Power Systems, Revised Edition, S. Chand & Co, 2022.
2. M.L. Sony, P.V. Gupta and U.S. Bhatnagar, A Course in Electrical Power, Dhanpath Rai & Co (P) Ltd., 2013.
3. C.L. Wadhwa, Electrical Power Systems, Eighth Multi Colour Edition, New Age International Publishers.
4. K.R. Padiyar, HVDC Power Transmission Systems Technology and System Interactions, Reprint, New Age International, 2005.

Web-based/Online Resources:

- https://www.tangedco.org/en/tangedco/about-us/generation/
- https://nptel.ac.in/courses/108102047
- https://pvwatts.nrel.gov/
- https://nptel.ac.in/courses/108105104
- https://onlinecourses.nptel.ac.in/noc20_ee39/preview
- https://www.tangedco.org/en/tangedco/about-us/

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1030234340	**MICROCONTROLLER AND EMBEDDED SYSTEMS**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

The dsPIC33CH dual-core Digital Signal Controller (DSC) allows separate design teams to develop software for each core independently and then integrate the code seamlessly into one chip. The dsPIC33CH DSC family is optimized for safety-critical applications requiring functional safety compliance and security. It enables running sophisticated algorithms.

Course Objectives:

The objective of this course is to enable the student to

- Understand the essential knowledge and skills of basic Digital Signal Processor encountered in professional practice for diploma holders.
- Comprehend the fundamental concepts and scope of Digital Signal Processor.
- Describe the properties dsPIC33CH dual-core Digital Signal Controller (DSC) allows separate design teams to develop software for each core independently and then integrate the code seamlessly into one chip.
- Examine the workings and applications of power transmission drives in mechanical systems.
- Understand the Industrial needs with the application of dsPIC33CH.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Remember Microcontroller and embedded systems and it's evolution.

CO2 : Understand dsPIC33CH architecture, memory and Interfacing techniques.

CO3 : Demonstrate dsPIC33CH with simple program.

CO4 : Examine dsPIC33CH with simple experiments.

CO5 : Develop their own power controls using dsPIC33CH.

Pre-requisites:

- Electrical Circuit Theory
- Analog and Digital Electronics
- C-Programming

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	2	3	2	3
CO2	3	2	3	2	3	3	3
CO3	3	-	3	3	3	3	3
CO4	3	3	3	3	3	3	3
CO5	3	2	3	2	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Algorithm or Flow Chart, Program and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Algorithm or Flow Chart	15
C	Program	10
D	Execution and Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Algorithm or Flow Chart	20
C	Program	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**INTRODUCTION TO MICROCONTROLLER**	Period
Introduction to Embedded systems and Microcontroller - Features of Microcontroller - Special Microcontroller for Power Electronics Application (PIC & as PIC) - About single-core and Multi-core systems.		2
UNIT II	**INTRODUCTION TO dsPIC33CH DUAL CORE DIGITAL SIGNAL CONTROLLER**	Period
dsPIC33 - Introduction to aspic Microcontroller - dsPIC33ch Features - Master and Slave core Features - Pin Details of dsPIC33CH512MP508 - Block diagram of aspic dsPIC33CH512MP508 - Targeted Application - Maser Module Register - Instruction set - Data Space Addressing - Addressing Modes – Programmer's Model - CPU Resources - Arithmetic Logic Unit - DSP Engine and Instruction.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Write a Program to Blink an LED connected to a General Purpose Input / Output (GPIO) pin.	8
2.	Write a Program to Read the state of a push-button and control an LED.	
Theory Portion:		
UNIT III	**MEMORY ORGANIZATION**	Period
Master Memory Organization - Program Address Space - Program Memory MAP For dsPIC33CH512MP508 Device - Program Memory Organization Interrupt and Trap Vectors - Unique Device Identifier (UDID) - Data Space Width - Data Memory Organization and Alignment - SFR Space MAPs - Paged Memory Scheme - Extended X Data Space.		2
UNIT IV	**ADDRESSING**	Period
Instruction Addressing Modes - File Register Instruction - MCU Instructions - MODULO Addressing - Interfacing Program and Memory Spaces.		2

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

UNIT IV	INTERFACING AND PERIPHERALS	Period
Understanding the concept of peripherals -Types of Peripherals - Introduction to internal peripherals of dsPIC microcontroller - Timer / Counter - High Resolution PWM - ADC - Universal Asynchronous Receiver Transmitter (UART) - Serial Peripheral Interface (SPI) - Inter Integrated Circuit (I2C) - LED interfacing - display interfacing - Stepper motor interfacing.		6
Practical Exercises:		
Ex.No	Name of the Experiment	Period
3.	Write a Program to Read Analog data from a potentiometer and display the data by using LCD.	12
4.	Write a Program to Establish communication between the dsPIC33CH and a computer using UART.	
5.	Write a Program to generate one PWM to drive an IGBT Switch to Control a DC Motor/Stepper Motor.	
6.	Write a program to generate PWM for Buck/Boost Converter	25
7.	Write a Program to read 2 channel ADC.	
8.	Write a Program to generate Sine PWM to Drive a IGBT to get a 50Hz sine waveform.	
9.	Write a Program to generate 3 Phase output from an Inverter Module.	
10.	Simulate a V/F Control of Induction Motor in MATLAB-SIMULINK & down load the program to a IGBT Power Module and run a 3 phase Induction Motor at 800RPM.	
Required Practical Instruction for all the Experiments		15
TOTAL PERIODS		**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.

Text and Reference Books:

1. Beginner's Guide to Programming the PIC24/dsPIC33: Using the Micro stick and Microchip C Compiler for PIC24 and dsPIC33
2. dsPIC33F Product Overview
3. Programming dsPIC MCUs in C
4. dsPIC33 Language Tools Libraries by Microchip.
5. The Beginner’s Guide to Designing with the dsPIC33 Microcontroller

Web-based/Online Resources:

1. https://www.microchip.com/en-us/products/microcontrollers-and-microprocessors/dspic-dscs/dspic33c/dspic33ch-dual-core-dsc
2. https://www.mouser.in/new/microchip/microchip-dspic33ch-dsc/
3. https://www.youtube.com/watch?v=r19Vxd_u5MI
4. https://www.amazon.in/Microchip-Technology-DM330028-dsPIC33CH-Development/dp/B07FML7CRK
5. https://www.tme.eu/Document/4644324b87bfbc44691614b542bf4ecb/dspic33ch_1.pdf

1030234340	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment	Quantity Required
1.	dsPIC33CH Dual Core Development Board	6 Nos
2.	a. Program / Interface kit to generate Sine PWM to Drive a IGBT to get a 50Hz sine waveform b. Function Generator c. Digital Signal Oscilloscope	Each 1 No
3.	Interface kit to generate 3 Phase output from a Inverter Module	1 No
4.	MATLAB-SIMULINK software	1 No
5.	Desktop Computers	6 Nos

<table>
<tr><td>1030234340</td><td rowspan="2">MICROCONTROLLER AND EMBEDDED SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>PRACTICUM</td><td>1</td><td>0</td><td>4</td><td>3</td></tr>
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End Semester Practical Exam

Model Question Paper

Duration: 3 Hours — Max. Marks: 100

List of Questions

1. Write a Program and Execute in dsPIC33CH to Blink an LED connected to a General-Purpose Input / Output (GPIO) pin.
2. Write a Program and Execute in dsPIC33CH to Read the state of a push-button and control an LED.
3. Write a Program and Execute in dsPIC33CH to Read Analog data from a potentiometer and display the data by using LCD.
4. Write a Program and Execute to Establish communication between the dsPIC33CH and a computer using UART.
5. Write a Program and Execute in dsPIC33CH to generate one PWM to drive an IGBT Switch to Control a DC Motor/Stepper Motor.
6. Write a Program and Execute in dsPIC33CH to generate PWM for Buck/Boost Converter.
7. Write a Program and Execute in dsPIC33CH to read 2 channel ADC.
8. Write a Program and Execute in dsPIC33CH to generate Sine PWM to Drive a IGBT to get a 50Hz sine waveform.
9. Write a Program and Execute in dsPIC33CH to generate 3 Phase output from an Inverter Module.
10. Simulate a V/F Control of Induction Motor in MATLAB-SIMULINK & down load the program to a IGBT Power Module and run a 3 phase Induction Motor at 800RPM.

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1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

A technician working in design and shop floor must possess the skill of preparing electrical estimation and drawings with the evolution of Computer software. The Computer Aided Drafting software will be used to perform various practical exercises in this course. This will enable the students to become competent for working in the fast-growing information technology environment by enhancing their computer aided drawing, designing skills in the field of electrical engineering.

Course Objectives:

The objective of this course is to enable the student to

- Understand I.E Rules 1956 and learn Toolbars in AutoCAD Software.
- Draw Electrical Symbols used in Electrical and Electronics circuits using AutoCAD.
- Practice Electrical Estimation for Residential and Industrial wirings.
- Practice in AutoCAD Software to draw the Single Line Diagrams of various Panels and Distribution Board.
- Practice in AutoCAD to draw Motor Winding Diagram, Substation Layout and Fire Alarm arrangements.

Course Outcomes:

On successful completion of this course, using Auto CAD the student will be able to

CO1	:	Explain the features and various tool bars of AutoCAD Software.
CO2	:	Draw the Electrical Symbols used in Wirings, Machines and Electronic Circuits.
CO3	:	Prepare Electrical Estimation for Residential and Industrial wirings.
CO4	:	Draw the Single Line Diagrams of various Panels and Distribution Board.
CO5	:	Draw the Motor Winding Diagram, Substation Layout and Fire Alarm arrangements.

Pre-requisites:

- Knowledge in Drafting Practices
- Basics of Electrical Engineering

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	3	-	1	1
CO2	3	1	1	3	-	1	1
CO3	3	1	1	3	-	1	1
CO4	3	1	1	3	-	1	1
CO5	3	1	1	3	-	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 6	Ex. 7 to 12	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Drawing, Printout, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description for CAD Ex.	Mark	Description for Ex: 5 to 8	Marks
A	Aim & Apparatus Required	05	Aim & Apparatus Required	05
B	Manual Drawing	10	Pipe Layout & Load Calculation	10
C	Circuit using CAD Software	30	Wiring Diagram & Material Calculation	20
D	Printout	05	Schedule of Materials with Cost	15
TOTAL		**50**	**TOTAL**	**50**
E	Practical Documents	10	Practical Documents (as per portions)	10
EXAM MARKS		**60**	**EXAM MARKS**	**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION
Model Practical and End Semester Examination- Practical Exam

Part	Description for CAD Ex.	Marks	Description for Ex: 5 to 8	Marks
A	Aim & Apparatus Required	05	Aim & Apparatus Required	05
B	Manual Drawing	10	Pipe Layout & Load Calculation	15
C	Circuit using CAD Software	45	Wiring Diagram & Material Calculation	25
D	Printout	10	Schedule of Materials with Cost	25
E	MCQ from Theory Portions	20	MCQ from Theory Portions	20
F	Viva Voce	10	Viva Voce	10
TOTAL MARKS		**100**	**TOTAL MARKS**	**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**ELECTRICAL SYMBOLS**	Period
	Need of Electrical symbols – List of Symbols – Brief study of Indian Electricity Rules 1956 (IE Rule : 28, IE Rule 30, IE Rule 31, IE Rule 54, IE Rule 56 and IE Rule 87) - Overview of Computer Aided Electrical Drafting – Overview of Various Toolbars in AutoCAD Software.	4

Practical Exercises:		
Ex.No.	Name of the Experiment	Period
1.	Draw the following Electrical Symbols using AutoCAD: Relay, Fluorescent Lamp, Ceiling Fan, Exhaust Fan, One Way Switch, 5A Socket Outlet with Switch, Energy Meter, Star Delta Starter, DC Shunt Motor, Step Down Transformer, PN Junction Diode, BJT, AND Gate, OR Gate.	5
2.	Draw the single line diagram of Three phase MCB Distribution Board.	5
3.	Draw the panel wiring diagram of Horizontal busbar arrangement with Incoming and Outgoing Switches using AutoCAD.	5
4.	Draw the single line diagram of typical Medium Voltage (MV Panel) with following feeders using AutoCAD. Incoming: One from EB and Another from DG with Interlock. Outgoing: 12 Outgoing feeders with various loads.	5

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

UNIT II	RESIDENTIAL AND INDUSTRIAL WIRING	Period
Introduction about Electrical Wiring - Looping back system, Joint box system and Tree system of wiring - Types of Internal Wiring – Over Head and Under Ground Service connections - Protection of electrical installation against overload, short circuit and earth fault – General requirements of electrical installations for Residential, Commercial and Industrial Wiring – Lighting and Power sub-circuits – Location of Main Switch, Distribution Board, Switch Board and Outlets - Steps to be followed in preparing electrical estimate - Building Plan - Wiring Pipe Layout - Wiring Diagram – Load Calculation.		8
Practical Exercises:		
Ex.No	Name of the Experiment	Period
5.	Estimate the quantity of Materials and Cost required for a single Bedroom residential building (1 BHK).	5
6.	Estimate the quantity of Materials and Cost required for street light service having 12 Lamps light fittings.	5
7.	Estimate the quantity of Materials and Cost required for Irrigation Pump wiring with 5 hp Induction Motor.	5
8.	Estimate the quantity of Materials and Cost required for Industrial power wiring having four machines.	5

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT III	**WINDING DIAGRAM AND SUBSTATION LAYOUT**	Period
Overview of AC Motor Winding Diagram and DC Motor Winding Diagram – Various components of Electrical Substation – Importance of Fire Alarm Arrangements in Multi Storey Building - Symbols used in Fire Alarm Arrangement.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
9.	Draw the Mush Winding Diagram of a Three Phase Induction Motor using AutoCAD.	5
10.	Draw the Winding Diagram of Lap Connected DC Armature with Commutator Connections and Brush Positions using AutoCAD.	5
11.	Draw the single line diagram of 110 KV / 11 KV Receiving Substation using AutoCAD.	5
12.	Draw the Single Line Diagram of Fire Alarm Riser Arrangement in typical Multi-Storey Building using AutoCAD.	5
	TOTAL PERIODS	**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

1. Activity 1: Collect various Electrical Schematic Layout/Drawings from A Grade Electrical Contractors and Analyse it by discussing the Types of Symbols used in Layouts, How the cable rating is mentioned in the drawings, Additional information provided in Drawings Sheets etc.,

2. Activity 2: 3 or 4 students may be formed as a group and Prepare the Building Plan, Pipe Layout and Wiring Diagram of college class room or Laboratory building. Submit the drawings as activity report.

1030234440	ELECTRICAL CAD DESIGN	L	T	P	C
PRACTICUM		1	0	4	3

Text and Reference Books:

1. K.B. Raina & S.K. Battacharya, Electrical Design Estimating and Costing, New Age International (p) limited, 2017.
2. M. Yokes, B. S. Nagaraja, N. Nandan, Computer Aided Electrical Drawing, PHI Learning Pvt. Ltd, 2014.
3. Sham Tickoo, Anurag, AutoCAD 2013 for Engineers and Designers, Wiley, 2012.

Web-based/Online Resources:

- http://students.autodesk.com/ (register and get free student version of LATEST AutoCAD software for approximately 3 year)
- https://www.autodesk.in/campaigns/autocad-tutorials

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	PC/Laptop	30 Nos.
2.	Electrical CAD Software Multi user	01 No
3.	UPS – 5KVA with half an hour battery backup	01 No

<table>
<tr><td>1030234440</td><td rowspan="2">ELECTRICAL CAD DESIGN</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>PRACTICUM</td><td>1</td><td>0</td><td>4</td><td>3</td></tr>
</table>

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours | Max. Marks: 100

List of Questions

1. Draw the following symbols using AutoCAD: Relay, Fluorescent Lamp, Ceiling Fan, Exhaust Fan, One Way Switch, 5A Socket Outlet with Switch, Energy Meter, Star Delta Starter, DC Shunt Motor, Step Down Transformer, PN Junction Diode, BJT, AND Gate and OR Gate.
2. Draw the single line diagram of Three phase MCB Distribution Board using AutoCAD.
3. Draw the panel wiring diagram of Horizontal busbar with Incoming and Outgoing Switch boards using AutoCAD.
4. Draw the single line diagram of typical Medium Voltage with following feeders using AutoCAD.
   Incoming: One from EB and Another from DG with Interlock.
   Outgoing: 12 Outgoing feeders with various loads.
5. Estimate the quantity of Materials and Cost required for a single Bedroom residential building (1 BHK).
6. Estimate the quantity of Materials and Cost required for Irrigation Pump wiring 5 hp Induction Motor.
7. Estimate the quantity of Materials and Cost required for Industrial power wiring having four machines.
8. Estimate the quantity of Materials and Cost required for street light service having 12 Lamps light fittings.
9. Draw the Mush Winding Diagram of a Three Phase Induction Motor using AutoCAD.
10. Draw the Winding Diagram of Lap Connected DC Armature with Commutator Connections and Brush Positions using AutoCAD.
11. Draw the single line diagram of 110 KV / 11 KV Receiving Substation using AutoCAD.
12. Draw the Single Line Diagram of Fire Alarm Riser Arrangement in typical Multi-Storey Building using AutoCAD.

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1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

Introduction:

In almost every home there are many of appliances that practically remain in use throughout the day to provide us the comfort and easiness of life that we deserve. We are really grateful to these appliances which are necessity of every home. Therefore, there is a tremendous scope for the repair & servicing centre's, especially in semi-urban and Rural Areas. So fundamental knowledge in the parts and servicing of Electrical appliances are essential for diploma engineers. This course aims to prepare unemployed youth to enable them in becoming successful as entrepreneur.

Course Objectives:

The objective of this course is to enable the student to

- Understand the key elements and connection diagram of Heating and Motorized domestic appliances.
- Predict the goodness and perform layman checks of domestic appliances.
- Develop professional skills for dismantling, problem diagnosis and rectification of fault in domestic appliances.
- Understand the techniques involved in advanced repairing of domestic appliances.
- Explain the installation procedure of OFF Grid Solar PV System.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Identify various parts of Heating and Motorized domestic appliances.
CO2	:	Interpret connection diagrams of Heating and Motorized domestic appliances.
CO3	:	Execute Servicing of Iron Box, Water Heater, Induction Stove and Micro Oven.
CO4	:	Execute Servicing of Fans, Mixer Grinder and Wet Grinders.
CO5	:	Install OFF Grid Solar PV system and test its working.

Pre-requisites:

- Basics of Electrical and Electronics Engineering.

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	3	2	-	1	1
CO2	3	1	3	2	-	1	1
CO3	3	1	3	2	-	1	1
CO4	3	1	3	2	-	1	1
CO5	3	1	3	2	1	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 4	Ex. 5 to 8	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7^{th} Week	14^{th} Week	15^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document consists of Aim, Apparatus Required, Circuit, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit / Connection Diagram	15
C	Dismantle & Identify the Parts	10
D	Checking, Re-assembling & Testing	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit / Connection Diagram	20
C	Dismantle & Identify the Parts	20
D	Checking, Re-assembling & Testing	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

Theory Portion :		
UNIT I	**DOMESTIC APPLIANCES I**	Period
	ELECTRICAL IRON BOX: Tools and instruments required for Servicing of Electrical Appliances - Various Parts of Non-Automatic and Automatic Iron Box – Connection Diagram – Common defects - Causes. ELECTRIC HEATER: Various Parts of Water Heater – Types of Water Heater – Parts of Room Heater - Connection Diagram of water Heater and Room Heater - Common defects – Causes. ELECTRIC FANS: Construction of Ceiling Fan - Connection Diagram – Checking of Capacitor - Common defects – Overview of Table Fan and Exhaust Fan. ELECTRIC MIXER GRINDER: Identification of various Parts - Working principles – Connection Diagram - Checking of carbon brush and OLR - Common defects - causes.	8

Practical Exercises: Perform the experiments by using actual electrical appliances and Trainer Kits are not allowed.		
Ex.No	Name of the Experiment	Period
1	SERVICING OF AUTOMATIC IRON BOX Activities to Perform: • Dismantle and Identify the parts of Iron Box. • Check the condition of thermostat and Power cord. • Do technical check (OC, SC and Earth Fault, etc.,) and Rectify the fault if any. • Re-assemble and Test its working with supply.	4

2	SERVICING OF WATER HEATER Activities to Perform: • Dismantle and Identify the parts of ceiling fan. • Check the condition of thermostat and Power cord. • Do technical check (OC, SC and Earth Fault, etc.,) and Rectify the fault if any. • Re-assemble and Test its working with supply.	4
3	SERVICING OF CEILING FAN & TABLE FAN Activities to Perform: • Dismantle and Identify the parts of ceiling fan and Table fan. • Check the condition of capacitor and bearings. • Do technical check (OC, SC and Earth Fault, etc.,) and Rectify the fault if any. • Re-assemble and Test its working with supply.	4
4	SERVICING OF MIXER GRINDER Activities to Perform: • Dismantle and Identify the parts of Mixer Grinder. • Check the condition of Carbon Brush, Selector Switch and OLR. • Do technical check (OC, SC and Earth Fault, etc.,) and Rectify the fault if any. • Re-assemble and Test its working with supply.	4

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

Theory Portion :		
UNIT II	**DOMESTIC APPLIANCES II**	Period
ELECTRIC WET GRINDER: Identification of various Parts - Connection Diagram - Common defects - causes. INDUCTION STOVE: Specifications – Various parts - Working Principle of Induction Stove – Features – Electrical Circuit Diagram - Common defects - causes. MICROWAVE OVEN: Various Parts – Connection Diagram – Testing Heating element - Checking and testing of Magnetron - Common defects - causes. OFF GRID SOLAR PV SYSTEM: Connection diagram of Solar Panel with Inverter/Charge Controller and Battery.		**7**
Practical Exercises:		Period
5	SERVICING OF WET GRINDER <u>Activities to Perform:</u> • Dismantle and Identify the parts of Wet Grinder. • Check the condition of Capacitor, Centrifugal Switch and Bearings. • Do technical check (OC, SC and Earth Fault, etc.,) and Rectify the fault if any. • Re-Assemble and Test its working with supply.	4
6	SERVICING OF PORTABLE INDUCTION STOVE <u>Activities to Perform:</u> • Dismantle and Identify the parts of Portable Induction Stove. • Do technical check by referring the Error Codes and Rectify the fault if any. • Re-Assemble and Test its working with supply.	3

7	SERVICING OF MICROWAVE OVEN Activities to Perform: • Dismantle and Identify the parts of Micro Oven. • Do technical test as per the service manual on Transformer, Magnetron, Capacitor, Motors and Control Panel and Rectify the fault if any. • Re-Assemble and Test its working with supply.	3
8	INSTALLATION OF OFF GRID SOLAR PV SYSTEM Activities to Perform: • Install of Solar Panel, Charge Controller, Inverter and Battery and make connections. • Do technical checks on above items and Rectify the fault. • Test its working with load.	4
	TOTAL PERIODS	**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

1. Activity 1: Four students can be grouped as a batch to prepare and submit the activity report of the following. Draw the wiring diagram, Write the various parts and tabulate the Troubleshooting Procedure of Washing Machine by referring service manual or Instruction manual or user manual of it.
2. Activity 2: Four students can be grouped as a batch to prepare and submit the activity report for the following. Measure the power and energy consumed by various domestic appliances by using Digital Power Monitor.
3. Activity 3: Perform troubleshooting of Indoor and Outdoor unit of Air Conditioner System.
4. Activity 4: Perform troubleshooting of Refrigerator unit.

Text and Reference Books:

1. L. Palaniappan, Hand Book on Home Appliances, First Edition, S.P. Publications, 2019.
2. K.B. Bhatia, Study of Electrical Appliances & Devices, Seventh Edition, Khanna publishers, 2024.
3. K.P.Anwer, Domestic Appliances Servicing, Fifth Edition, Scholar Institute Publications, 2018.
4. Service Manual of Corresponding Brand of Domestic Appliances.

Web-based/Online Resources:

- Sway am Online Course Portal: https://youtu.be/FZU5VrfFA70

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

Equipment / Facilities required to conduct the Practical Course Requirement: (For a Batch of 30 Students)

LIST OF EQUIPMENT

S No	Name of the Equipment	Quantity Required
1.	Non-Automatic and Automatic Iron Box	Each 2 Nos
2.	Electric Water Heater (Wall Mounted)	2 Nos
3.	Ceiling Fan and Table Fan	Each 2 Nos
4.	Mixer Grinder	2 Nos
5.	Wet Grinder	2 Nos
6.	Portable Induction Stove	2 Nos
7.	Micro Oven	2 Nos
8.	100W Solar Panel, Inverter/Charge Controller and Battery	2 Set
9.	Tools Set	6 Nos
10.	Digital Multimeter	6 Nos
11.	Digital Power Monitor	2 Nos
12.	Bench Vice	1 No
13.	Series Test Board	As required
14.	Display Charts for Parts of above Appliances	Each 1 No
15.	Service Manual of Each Appliances	Each 1 No

1030234540	SERVICING OF ELECTRICAL APPLIANCES	L	T	P	C
PRACTICUM		1	0	2	2

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours   Max. Marks: 100

List of Questions

1. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Automatic Iron box.
2. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Water Heater.
3. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Ceiling Fan.
4. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Mixer Grinder.
5. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Wet Grinder.
6. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Portable Induction Stove.
7. Perform Dismantling, Identification of parts, Technical Checking, Re-assembling and Testing of Microwave Oven.
8. Perform Installation of OFF Grid Solar PV System and Test its Performance.

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1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Introduction:

The syllabus for Electrical Machines – II Practical is designed to offer students a comprehensive, hands-on understanding of various electrical machines, focusing particularly on alternators, induction motors, and their applications in electrical engineering. The rationale behind including each exercise in the syllabus is grounded in both educational and practical considerations, aimed at equipping students with the necessary skills and knowledge to excel in the field.

Course Objectives:

The objective of this course is to enable the student to

1. Assess the performance of a three-phase alternator under varying loads, ensuring voltage and frequency stability.
2. Determine voltage regulation using the EMF method, measuring no-load voltage and analyzing regulation across different loads.
3. Sync alternators with the grid or another alternator, ensuring precise phase and frequency alignment.
4. Analyze the performance of three phase induction motors, including torque-speed characteristics and efficiency, under diverse loads.
5. Establish resistance, reactance, and leakage coefficients for precise modeling of three-phase induction motor.
6. Demonstrate techniques such as capacitor banks to enhance power factor, reducing reactive power consumption and enhancing system efficiency.
7. Conduct load analysis to single phase induction motor and understand torque-speed characteristics and efficiency.
8. Perform Transformer windings and End connection in three phase squirrel cage induction motor.

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Course Outcomes:

After successful completion of this course, the students will be able to

CO1 : Grasp alternator operation, performance, and voltage regulation using EMF method.

CO2 : Synchronize proficiently 3-phase alternators using lamp and synchroscope method.

CO3 : Compare slip ring and squirrel cage motor performance via load testing.

CO4 : Develop skills in determining induction motor constants and Demonstrate power factor improvement using capacitors.

CO5 : Access single-phase induction motor performance through load testing for efficiency insight.

Pre- requisites:

- Electrical Circuit Theory
- Electrical Machines II Theory.

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	-	3	-	-	2
CO2	3	1	-	3	1	1	2
CO3	3	1	1	3	1	-	2
CO4	3	3	-	3	-	-	2
CO5	3	2	1	3	-	2	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Instructional Strategy:

- **Demonstrations:** Conduct live demonstrations of load testing procedures for the three-phase alternator, slip ring and squirrel cage induction motors, and single-phase induction motor. Show step-by-step processes and highlight key measurements and observations.

- **Hands-on Practical Sessions:** Provide students with opportunities to conduct load tests on various electrical machines in a laboratory setting. Allow them to operate testing equipment, collect data, and analyze results under the supervision of instructors.

- **Problem-Based Learning:** Assign problem-solving tasks related to predetermining alternator regulation, determining equivalent circuit constants of induction motors, and optimizing power factor. Encourage students to apply theoretical knowledge to real-world scenarios.

- **Interactive Workshops:** Organize workshops on synchronization methods, load testing techniques, and power factor improvement strategies. Allow students to actively participate through discussions, role-plays, and hands-on activities.

- **Peer Learning:** Facilitate peer learning sessions where students can share their experiences, discuss challenges, and provide feedback to each other. Encourage peer teaching and collaboration to enhance comprehension and retention of concepts.

- **Formative Assessment:** Conduct regular quizzes, assignments, and in-class exercises to assess students' understanding of key concepts and monitor their progress throughout the course. Provide constructive feedback to guide their learning journey.

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 11	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	60	60	Each Practical 10 Marks	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	15
C	Connection	10
D	Execution and Output/Result	20
TOTAL MARKS		**50**

- **CA 3:** Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Tabulation, Graph, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The same should be evaluated for 10 Marks. The total marks awarded should be converted to 10 Marks for the internal assessment. The practical document should be submitted for the Practical test.

- **CA 4:** All the exercises/experiments should be completed and kept for the model practical examination. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Circuit Diagram	25
C	Connections	25
D	Execution and Output/Result	30
E	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1	Conduct Load test on 3 Phase Alternator.	5
2	Predetermine the Regulation of Three Phase Alternator by EMF method.	5
3	Synchronization of 3 Phase Alternators by a) Lamp method. b) Synchroscope method	6
4	Conduct Load Test on a three phase squirrel cage induction motor and plot the performance curve.	6
5	Conduct Load Test on a three phase slip-ring induction motor and plot the performance curve.	6
6	Find the equivalent circuit constants of a three phase induction motor by conducting No-Load and Blocked Rotor tests.	6
7	Demonstrate that power factor of an induction motor load is improved by connecting capacitor bank.	6
8	Conduct Load Test on a single phase induction motor and plot the performance curve.	5
9	Determination the 'V' curve and inverted 'v' curve of synchronous motor.	6
10	Perform Winding of primary and secondary coils of 230V/12V, 500mA Transformer. Insert suitable cores and Check the output voltage.	6
11	Make end connection to a three phase induction motor winding for a two pole/four pole operations and verify the output.	3
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Case Studies: Present case studies on power factor improvement techniques, synchronization methods for three-phase alternators, and performance prediction of induction motors. Analyze real-world examples to deepen understanding and stimulate critical thinking.
- Simulations: Utilize computer simulations to replicate load testing procedures, synchronization techniques, and performance analysis of electrical machines.

Simulations offer a risk-free environment for students to explore different scenarios and outcomes.

- Group Projects: Assign group projects where students design and implement load testing protocols, analyze data, and present findings. Encourage collaboration and teamwork to foster communication and problem-solving skills.
- Guest Lectures: Invite industry experts to deliver guest lectures on topics such as power factor correction, synchronous motor characteristics, and practical applications of electrical machines. Provide insights into current trends and real-world challenges.

General Guidelines:

- Preparation: Before each class, ensure all equipment is functional and safety protocols are in place.
- Demonstration: Initially, demonstrate each experiment or test procedure to the students.
- Hands-On: Encourage students to perform experiments in groups, under supervision, to ensure engagement and understanding.
- Discussion: After experiments, hold discussions to interpret results and relate them to theoretical concepts.
- Assessment: Evaluate students through quizzes, lab reports, and presentations on their understanding and analysis of the experiments.

Text and Reference Books:

1. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology Volume - II (AC and DC Machines), Multicolour Edition, S. Chand & Co., 2005
2. V.K. Mehta & Rohit Mehta, Principles of Electrical Machines, Second Edition, S. Chand & Co.,2019
3. S. K. Bhattacharya, Electrical Machines, Third Edition, McGraw Hill Education, 2008.
4. Ashfaq Husain, Haroon Ashfaq, Electric Machines, Third Edition, Dhanpat Rai & Co. (P) Ltd., 2016.

Web-based/Online Resources:

- IEEE Xplore Digital Library: https://ieeexplore.ieee.org/

- All About Circuits: https://www.allaboutcircuits.com/
- Electrical4U: https://www.electrical4u.com/
- Engineering360 from IEEE: https://www.engineering360.com/
- Khan Academy: https://www.khanacademy.org/
- Learn Engineering: https://www.learnengineering.org/
- Electrical Engineering Portal: https://electrical-engineering-portal.com/

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Equipment / Facilities required to conduct the Practical Course Requirement: (For a Batch of 30 Students.

S.No	LIST OF EQUIPMENT	QUANTITY REQUIRED
1.	3KW, 415V, 50Hz Three Phase Alternator with prime mover.	2 Nos
2.	5HP, 440V, 1440 rpm Three Phase Squirrel Cage Induction motor with starting and loading arrangement.	2 Nos
3.	5HP, 440V, 1440 rpm Three Phase Squirrel Cage Induction motor without starting and loading arrangement.	1 No
4.	5HP, 440V, 1440 rpm Three phase Slip ring Induction motor with starting and loading arrangement.	1 No
5.	2HP, 250V, 1440 rpm Single phase induction motor with staring and loading arrangement.	1 No
6.	5HP/3HP, 440V, 1500 rpm Synchronous Motor with starting and loading arrangement.	1 No
7.	Alternator Synchronizing panel	1 No
8.	MI Voltmeter (0 - 600V)	4 Nos
9.	MI Voltmeter (0 - 150/300V) & MC Ammeter (0 - 2A)	Each 2 Nos
10.	MI Ammeter (0 - 10/20A)	3 Nos
11.	Wattmeter (600V,10A) UPF	4 Nos
12.	Wattmeter (600V, 5A) LPF	2 Nos
13.	Wattmeter (300V, 10A) UPF	1 No
14.	Rheostat : 400Ω/1A or Suitable Range	2 Nos
15.	Rheostat 530Ω/1A or Suitable Range	3 Nos
16.	Rheostat :40Ω/6A & Rheostat 1180Ω/0.6A	Each 2 Nos
17.	Capacitor bank (2 KVAR,1000V)	2 Nos
18.	Three Phase Induction Motor with End Connection Terminals	1 No
19.	Winding Machine	1 No
20.	Copper coil, E and I Cores and Bobbin	As required

1030234620	ELECTRICAL MACHINES II PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours   Max. Marks: 100

List of Questions

1. Conduct Load test on 3 Phase Alternator and plot the load characteristics curve.
2. Predetermine the Regulation of Three Phase Alternator by EMF method.
3. Perform Synchronization of 3 Phase Alternators by
   a) Lamp method   b) Synchroscope method
4. Conduct Load Test on a three phase squirrel cage induction motor and plot the performance curve.
5. Conduct Load Test on a three phase slip-ring induction motor and plot the performance curve.
6. Find the equivalent circuit constants of a three phase induction motor by conducting No-Load and Blocked Rotor tests.
7. Demonstrate that power factor of an induction motor load is improved by connecting capacitor bank.
8. Conduct Load Test on a single phase induction motor and plot the performance curve.
9. Conduct and Experiment to obtain the 'V' curve and inverted 'v' curve of synchronous motor.
10. Perform Winding of primary and secondary coils of 230V/12V, 500mA Transformer. Insert suitable cores and Check the output voltage.
11. Make end connection to a three phase induction motor winding for a two pole/four pole operations and verify the output.

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Regulation 2023

Diploma in Electrical and Electronics Engineering

V SEMESTER SYLLABUS

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

Introduction:

Power system protection and utilization are crucial for ensuring the reliability, safety, and sustainability of electrical power systems. Power system protection encompasses a set of techniques, devices and strategies designed to detect, isolate, and mitigate faults or abnormalities in electrical networks. These faults could include short circuits, overloads, insulation failures, and other potential disturbances that may lead to equipment damage, power outages, or even hazardous conditions. The primary objective of power system protection is to swiftly isolate the faulty components while maintaining the integrity and stability of the overall power system. Effective protection mechanisms safeguard equipment, prevent disruptions, and reduce downtime, thereby enhancing system reliability. Efficient utilization practices contribute to energy conservation, cost savings, and environmental sustainability by promoting optimal use of electrical resources and encouraging the adoption of clean energy technologies.

Course Objectives:

The objective of this course is to enable the student to

- Understand the significance of protection, protection schemes, common faults in power system apparatus and applying suitable protective schemes.
- Understand the functioning of relays and circuit breakers.
- Understand the principles of electric traction systems and the technology to optimize modern electric traction systems.
- Explore theories and practices of electric illumination, covering lighting design principles, technologies and energy efficiency.
- Examine principles of electric heating and welding, encompassing techniques, equipment, safety protocols, and applications

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand and select proper protective scheme for different major electric equipment.

CO2 : Understand the fundamentals of relays and circuit breaker.

CO3 : Describe the principles of electric traction systems.

CO4 : Understand the fundamentals of illumination systems and to design for few applications.

CO5 : Demonstrate the utilization of electrical energy for heating and welding purposes.

Pre-requisites:

- Basic Electrical Engineering
- Electrical Machines I
- Electrical Machines II
- Generation, Transmission and Distribution

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	-	-	-
CO2	3	1	2	1	-	-	-
CO3	3	2	3	1	-	-	-
CO4	3	2	3	1	-	-	-
CO5	3	1	2	1	-	-	-

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

Instructional Strategy:

- Begin by introducing foundational concepts such as electrical networks, power generation, transmission, and distribution systems.
- Explain the importance of power system protection and utilization in ensuring the reliability, safety, and efficiency of electrical power systems.
- Present case studies of power system failures or incidents and analyze the role of protection systems in preventing or mitigating the consequences.
- Explain the advantages of electric traction, such as higher efficiency, lower emissions, and reduced dependence on fossil fuels.
- Introduce illumination principles, lighting technologies, design considerations, and energy efficiency through interactive activities, case studies, and practical demonstrations.
- Cover fundamental principles of electric heating and welding, safety precautions, equipment operation, and applications.
- Assess learners' understanding through quizzes, assignments, or project–based assessments.
- Encourage peer feedback discussion, and reflection to evaluate learning outcomes and identify areas for improvement.

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

<u>Instructions to the Question Setters:</u>

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**PROTECTION SCHEMES**	Period
Protection Schemes: Significance and need for protective schemes – Nature and causes of faults – Types of faults – Effects of faults – Zones of protection. Equipment Protection: Applications of Current Transformers (CT) and Potential Transformers (PT) in protection schemes – Protection of Transformer. Over Voltage Protection: Voltage surge – Causes of Over Voltage– Lightning– Direct stroke, Indirect stroke – Protection against lightning – Earthing screen, Overhead Ground Wires, Lightning Arresters – Expulsion Type, Gapless Arrester. Fuses: Construction and Working of HRC Fuse – H.V. Fuses.		9
UNIT II	**RELAYS AND CIRCUIT BREAKERS**	Period
Relays: Basic principle –– Relay characteristics – Relay timing – Instantaneous relay – Inverse time relay and Definite time lag relay – Inverse definite minimum time relay - Primary and back up Protection - Classification of relays – Induction type over current relay (Directional and Non directional), Differential relay – Over Current relay – Distance relay. Static Relays: Basic elements of static relay. Circuit Breakers: Arcing phenomenon and Arc interruption – Re–Striking Voltage and Recovery Voltage – Rate of rise of recovery voltage –Types of circuit breakers – Air Blast, Oil, SF_6 and Vacuum Circuit Breakers – HVDC Breaker.		9

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

UNIT III	ELECTRIC TRACTION	Period
Fundamentals of electric drive – Factors governing the selection of Electric Motor – Different types of electrical drives – Application of Motors for Particular Services – Characteristic Features of Traction Motor – Advantages and Disadvantages of Electric Traction – Over Head Equipment – Contact Wire, Centenary and Droppers and Collection Gear – Bow and Pantograph Collector – Different Systems of Track Electrification. Traction Mechanics: Units and Notations used in Traction Mechanics – Speed Time Curve for Different Services – Simplified Speed Time Curve – Energy Saving with Series Parallel Starting – Shunt Transition – Bridge Transition – Multiple Unit Control – Regenerative Braking – Magnetic Levitation (MAGLEV).		9
UNIT IV	**ILLUMINATION**	Period
Introduction – Definition and meaning of terms used in illumination engineering – Classification of light sources – Incandescent lamps – Sodium Vapour Lamps – Mercury Vapour Lamps – Fluorescent Lamps – Energy Saving Lamps – CFL – LED – Recent trends in lighting systems. Lighting schemes – Indoor lighting schemes – Factory lighting – Outdoor lighting schemes – Flood lighting – Street lighting – Lighting control using Sensors and IoT.		9

1030235110	POWER SYSTEM PROTECTION AND UTILIZATION	L	T	P	C
THEORY		3	0	0	3

UNIT V	ELECTRIC HEATING AND WELDING	Period
Introduction – Advantages of electric heating – Methods of electric heating – Resistance heating – Infrared Heating – Arc Heating – High Frequency Electric Heating – Induction Heating – Eddy Current Heating and Dielectric Heating. Electric Furnaces: Resistance Furnace – Arc Furnace – Direct and Indirect Arc Furnace – Induction Furnace – Direct and Indirect Core Type Induction Furnace – Coreless Induction Furnace. Electric Welding: Resistance Welding – Arc Welding – Ultrasonic Welding - Laser Beam Welding.		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Power point presentation on “Technology in recent superfast trains”.
- Group Discussion on “Design procedure for lighting schemes using Flood lighting.
- Case study of HVAC (Heating, Ventilation and Air conditioning) in Industry.
- Quiz Questions on each topic can be asked at the end of each unit.

Text and Reference Books:

1. Sunil S.Rao, Switchgear and Protection, Fourth Edition, Khanna Publishers, 2010.
2. C.L. Wadhwa, Generation, Distribution and Utilisation of Electrical Energy, New Academic Science, New Delhi, 2011
3. S.L. Uppal, S. Rao, Electrical Power Systems, Fifteenth Edition, Khanna Publishers, 2009.
4. B. Rabindaranath, M. Chander, Protective System Protection and Switchgear, New age International, 2012.

Web-based/Online Resources:

- NPTEL Videos Lecture 01: Faults in Power System IIT Kharagpur https://youtu.be/WPmOB31UTkI?si=3uqr7o_C4nC9whoo
- NPTEL: Interior Lighting https://youtu.be/gWv4lx6y2Qw?si=XKnI181-P-ahu1xi.

1030235210	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Introduction:

Hybrid electric vehicles are powered by an internal combustion engine and one or more electric motors, which uses energy stored in batteries. A hybrid electric vehicle cannot be plugged in to charge the battery. Instead, the battery is charged through regenerative braking and by the internal combustion engine.

Course Objectives:

The objective of this course is to enable the student to

- Understand the concept of electric vehicles.
- Study about the motors & drives for electric vehicles.
- Understand the electronics and sensors in electric vehicles.
- Understand the concept of hybrid vehicles.
- Study about fuel cell for electric vehicles

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Describe about working principle of electric vehicles.

CO2 : Explain the construction and working principle of various motors used in electric vehicles.

CO3 : Understand working principle of electronics and sensor less control in electric vehicles.

CO4 : Understand working principle of hybrid vehicles.

CO5 : Illustrate the various types and working principle of fuel cells

Pre-requisites:

- Basics of Science and Engineering.

1030235210	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	-	1	1	2
CO2	3	1	2	2	1	1	2
CO3	3	1	2	2	1	1	2
CO4	3	1	2	2	1	1	2
CO5	3	1	2	2	1	1	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030235210	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030235210	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**INTRODUCTION TO ELECTRIC VEHICLES**	Period
Electric Vehicle – Need - Types – Cost and Emissions – End of life - Electric Vehicle Technology – Layouts – Cables – Components – Controls - Batteries – Overview and its types - Battery plug-in and life - Ultra-capacitor Charging – Methods and Standards - Alternate charging sources – Wireless & Solar.		9
UNIT II	**ELECTRIC VEHICLE MOTORS**	Period
Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control - Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design - Peak Power Source (PPS) - Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling - Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor and Design.		9
UNIT III	**ELECTRONICS AND SENSOR-LESS CONTROL IN EV**	Period
Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors – Inverters – Safety: Risks and Guidance, Precautions, High Voltage safety, Hazard management – Sensors: Autonomous EV cars, Self-drive Cars, Hacking - Sensor less: Control methods - Phase Flux Linkage-Based Method, Phase Inductance Based, Modulated Signal Injection, Mutually Induced Voltage-Based and Observer-Based.		9
UNIT IV	**HYBRID VEHICLES**	Period
Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in – EV Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components - Regenerative Braking – Economy - Vibration and Noise reduction - Hybrid Electric Vehicles System: Analysis, Types and Controls.		9

1030235210	ELECTRIC VEHICLE TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

UNIT V	**FUEL CELLS FOR ELECTRIC VEHICLES**	Period
Fuel cell – Introduction, Technologies & Types - Obstacles - Operation principles - Potential and I-V curve - Fuel and Oxidation Consumption - Fuel cell Characteristics – Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and freeze capacity - Lifetime cost of Fuel cell Vehicle – System, Components, maintenance.		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Mini project that shall be an extension of any practical lab exercise to real-world application.

Text and Reference Books:

1. Jack Erjavec and Jeff Arias, Hybrid, Electric and Fuel Cell Vehicles, Cengage Learning, 2012 .
2. Jack Erjavec and Jeff Arias, Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles, Cengage Learning Pvt. Ltd., New Delhi, 2007.
3. 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.

Web-based/Online Resources:

- NPTEL Electrical Vehicle Technology.
- https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work
- https://e-amrit.niti.gov.in/types-of-electric-vehicles
- https://www.niti.gov.in/sites/default/files/2021-08/HandbookforEVChargingInfrastructureImplementation081221.pdf

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Electronic control circuits play major role in industries. In this era of automation in industry and manufacturing sector, the mechanical controls are largely replaced by power electronic devices. In this context this course aims at acquainting the pass outs with a comprehensive knowledge base about the devices and circuits used in Electrical Power so that they can maintain the control circuits used in the field. Hence this course has been designed to achieve this aim.

Course Objectives:

The objective of this course is to enable the student to

- Explain the operating region and rating of SCR.
- Explain the trigger and commutation circuits of SCR.
- Familiarize with the phase controlled rectifier circuits.
- Understand the operation of cyclo converter.
- Understand the working of choppers and inverters.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand and construct the trigger and commutation circuits of SCR.
CO2 : Understand the Line commutated power control circuits.
CO3 : Understand the working of different types of choppers and inverters.
CO4 : Understand the basics of DC Drives
CO5 : Understand the basics of AC Drives

Pre-requisites:

- Basics of Electrical and Electronics Engineering
- Analog and Digital electronics
- Electrical Machines I
- Electrical Machines II.

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	2	2	-	1	2
CO2	3	1	2	2	-	1	2
CO3	3	1	2	2	-	1	2
CO4	3	1	2	2	-	1	2
CO5	3	1	2	2	-	1	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7^{th} Week	14^{th} Week	15^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Tabulation / Graph, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	15
C	Connection	10
D	Execution and Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	20
C	Connections	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**COMMUTATION CIRCUITS AND PHASE CONTROLLED RECTIFIERS**	Period
	Power Electronics: Definition – Scope and Applications – Power Electronic Switch Specifications – Types of Power Electronic Circuits. SCR – rating and their importance, Symbol, Circuit, Working, Characteristics and Applications - Line Synchronized UJT Triggering Circuits - Working, Characteristics and Applications of IGBT and MOSFET. **Commutation Circuits**: SCR Turn Off Methods – Natural Commutation – Forced Commutation – Class A, Class B, Class C, Class D, Class E and Class F. **Phase Controlled Rectifiers:** Introduction – Phase Controlled Rectifiers - Single Phase Fully Controlled Bridge with R Load, RL Load - Single Phase Dual Converter - Three Phase Fully Controlled Bridge with RL Load - Introduction to Single Phase Cyclo Converter with Simple Circuit.	7

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Construct the Line synchronized Ramp trigger circuit using UJT with AC Load to measure firing angles.	6
2.	Construct and test the SCR commutation circuits.	6
3.	Construct and test a Half wave controlled rectifier with R Load.	6
4.	Construct and test a Single phase fully controlled bridge rectifier with RL- Load.	6
5.	Construct and test the Single phase to single phase Cyclo converter.	6

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:		
UNIT II	**CONVERTERS AND APPLICATIONS OF POWER ELECTRONICS**	Period
Choppers: Introduction, Principle of Chopper Operation. Control Strategies – Constant Frequency System and Variable Frequency System - Circuit Diagram and Working – Step Up Chopper - Four Quadrant Choppers. **Inverters**: Introduction, Classification of Inverter. Circuit Diagram, Working and Waveform - Full Bridge Inverter - Three Phase Bridge Inverter Under 180° Mode & 120° Mode Operations - Pulse Width Modulated Inverters, (Single Pulse, Multiple Pulse, Sinusoidal Pulse). **DC Drives**: Basic DC Motor Speed Equation- Circuit Diagram, Output Waveforms and Output Equation of – Separately Excited DC Motor – Single Phase Full Converter Drives. **AC Drives**: Speed Control by Rotor Resistance for Slip Ring Induction Motors – Static Scherbius Drive (Slip Power Recovery Scheme) - Variable voltage and Variable frequency drive - Block Diagram.		8
Practical Exercises:		
Ex.No	Name of the Experiment	Period
6.	Design the PWM based step down DC Chopper using MOSFET/IGBT.	6
7.	Construct and test the Single phase Single pulse / Sinusoidal PWM inverter using MOSFET/IGBT.	6
8.	Construct and test the ON / OFF control of Lamp using solid state Relay.	6
9.	Construct and test the Speed Control of AC Motor using VFD drive.	6
10.	Construct a Lamp dimmer circuit using TRIAC.	6
	TOTAL PERIODS	**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course
- Viva Voce will be conducted before conducting an experiment

Text and Reference Books:

1. MD Singh, K.B. Khanchandani, Power Electronics, Seventh reprint, Tata Mc Graw Hill Publishing Company Ltd, 2005.
2. Mohammed H. Rashid, Power Electronics, Third Edition, New age publication, 2004.
3. William P. Robbins, Ned Mohan, Tore M. Undeland, Power Electronics: Converters, Applications and Design, Third Edition, Wiley, 2002.

Web-based/Online Resources:

- https://www.electronicsforu.com/technology-trends/learn-electronics/understanding-power-electronics
- https://www.geeksforgeeks.org/power-electronics
- https://www.youtube.com/watch?v=1Auay7ja2oY – NPTEL Lecture Series on Power Electronics by Prof. B.G. Fernandes, Department of Electrical Engineering, IIT Bombay.

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	Line synchronized Ramp trigger circuit using UJT	3 Nos.
2.	SCR commutation circuit kit	1 No.
3.	Half wave controlled rectifier kit	1 No.
4.	Single phase fully controlled bridge rectifier with RL- Load	1 No.
5.	Single phase to single phase cyclo converter kit	1 No.
6.	PWM based step down DC chopper using MOSFET/IGBT kit	1 No.
7.	Single phase Single pulse / Sinusoidal PWM inverter using MOSFET/IGBT kit	1 No.
8.	Solid state Relay	1 No.
9.	Lamp 60W	1 No.
10.	Variable Frequency Drive (VFD)	1 No.
11.	Single Phase/Three Phase Induction Motor	1 No
12.	TRIAC - BT136, DIAC - DB32, Resistor - 2KΩ,26Ω, Capacitor - 0.01µf, Potentiometer - 1 MΩ	Each 1 No
13.	CRO	5 Nos.

1030235340	POWER ELECTRONICS	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Construct the Line synchronized Ramp trigger circuit using UJT with AC Load to measure firing angles.
2. Construct and test the SCR commutation circuits.
3. Construct and test a Half wave controlled rectifier with R Load.
4. Construct and test a Single phase fully controlled bridge rectifier with RL- Load.
5. Construct and test the Single phase to single phase Cyclo converter.
6. Construct PWM based step down DC Chopper using MOSFET/IGBT.
7. Construct and test the Single phase Single pulse / Sinusoidal PWM inverter using MOSFET/IGBT.
8. Construct and test the ON / OFF control of Lamp using solid state Relay.
9. Construct and test the Speed Control of AC Motor using VFD drive.
10. Construct a Lamp dimmer circuit using TRIAC.

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1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Nearly all the industrial equipment that you find in a modern manufacturing facility shares one thing in common - computer control. The most commonly used controller is the PLC. PLC is using a programming language called Ladder Logic. Its format is similar to the electrical style of drawing known as the “ladder diagram”. A diploma holder when employed in automated industrial process controls will be required to know the basics of Programmable Logic Controllers, their working and their programming.

Course Objectives:

The objective of this course is to enable the student to

- Understand the role of each component of PLC system.
- Practice Relay Type Instructions and Timers Instructions in PLC Programming.
- Implement Counter, Math and Compare Instructions in conveyor applications.
- Explain the importance of Analog I/O Module in PLC.
- Learn the concept of I/O Bus networks and SCADA.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Describe the importance of typical components of a PLC.

CO2 : Develop and Execute PLC Program using Relay type and Timer Instructions.

CO3 : Develop and Execute PLC Program using Counter and Compare Instructions.

CO4 : Develop and Execute PLC Program using Analog Input Instruction.

CO5 : Describe the importance of I/O Bus networks and SCADA in automation.

Pre-requisites:

- Basics of Electrical and Electronics Engineering.

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	3	2	-	1	2
CO2	3	2	3	2	-	1	2
CO3	3	2	3	2	-	1	2
CO4	3	2	3	2	-	1	2
CO5	3	2	3	2	1	1	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.
- In theory class period, use simulation tools to develop and execute the ladder logic for better understanding.

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Cycle I Ex.	Cycle 2 Ex.	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.
  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Ladder Diagram, Interfacing circuit, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Ladder Diagram	15
C	Connections / Interfacing	10
D	Execution and Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Ladder Diagram	20
C	Connections / Interfacing	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:		
UNIT I	**INTRODUCTION TO PLC**	Period
Automation – Components of Automation - Factory Automation and Process Automation – Advantages of Automation - Block diagram of PLC – Principle of operation – PLC Scan – Advantages of PLC. Typical Discrete I/O field Devices – Sinking and Sourcing I/O modules – Relay output module – Isolated output module - Criteria for selection of suitable PLC – List of PLCs available in the market – Develop ladder logic program using Relay type instructions - Introduction about Timer Instructions – ON Delay and OFF Delay Timer – Retentive Timer Instruction.		7

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	PLC BASED DOL STARTER <u>Sequence of Operation:</u> Develop and Execute Ladder Logic in PLC for DOL Starter Operation with Single Phasing Prevention. Check the output by interfacing PLC with three phase Cage Induction Motor.	5
2	INTERFACING OF DISCRETE FIELD DEVICES WITH PLC <u>Sequence of Operation</u>: Develop Ladder Logic in PLC to execute the following logical relation between the input and output field devices. • Y = A + B + C + D • Y = A . B .C . D • Y = (A+B) . (C+D) • Y = (A.B) + (C.D) Interface Push Button (A), Limit Switch (B), Reed Switch (C) and 3 wire Proximity Sensor (D) and Buzzer (Y) with PLC and check the output.	5

3	PLC BASED STAR DELTA STARTER Sequence of Operation: Develop and Execute Ladder Logic in PLC for Automatic Star- Delta Starter Operation. Check the output by interfacing PLC with three phase cage induction motor.	5
4	PLC BASED FORWARD AND REVERSE CONTROL OF INDUCTION MOTOR* Sequence of Operation: Develop and Execute Ladder Logic in PLC to control three phase induction motor in Forward and Reverse direction of Rotation. Interface external pilot lamp with PLC to indicate the direction of rotation. Check the output by interfacing PLC with three phase cage induction motor.	5
5	PLC BASED CONVEYOR SYSTEM WITH PRE WARNING SIREN Sequence of Operation: Develop and Execute Ladder Logic in PLC using an ON delay timer to delay the start of a conveyor. While press the START button, activate the Warning Siren for Pre-set Time. After the Pre-Set time delay the Warning siren turns OFF and the conveyor starts running. When STOP button is pressed turns OFF the conveyor.	5
6	PLC BASED WATER LEVEL CONTROL SYSTEM Sequence of Operation: Develop and Execute Ladder Logic in PLC to fill the empty tank with liquid when the START button is pressed. When liquid reaches the HIGH Level, turn OFF the Pump Motor and turn ON the Solenoid Valve to drain the liquid from tank. When liquid reaches the LOW Level, turn OFF the Solenoid Valve and turn ON the Pump Motor for refilling. Interface external pilot lamp with PLC to indicate the operation of Pump Motor and Solenoid Valve.	5

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:		
UNIT II	**COUNTERS, MATH & DATA COMPARE INSTRUCTIONS.**	Period
Introduction about Counter Instructions – UP Counter – DOWN Counter – Applications of Counter Instructions – Math Instructions - Data Compare Instructions – Simple programs using above instructions.		3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
7	PLC BASED COUNTING OF MOVING OBJECTS ON A CONVEYOR Sequence of Operation: Develop and Execute ladder logic in PLC for counting the object moving in the conveyor. Interface manual START and STOP push buttons to operate the conveyor motor and Proximity sensor detect the object. Interface buzzer to give beep sound while sensor is detecting the product. When the pre-set value of count has reached turn OFF the conveyor automatically.	5
8	PLC BASED COUNTING OF MOVING OBJECTS ON TWO CONVEYORS Sequence of Operation: A manufacturing plant is arranged with 2 feeder conveyors for transferring the Objects into the plant. Develop and Execute Ladder Logic using math instruction in PLC to get the total number of objects transferred by 2 conveyors into the Plant. When the count of total object has reached pre-set count value, turn ON buzzer to give beep sound for 1 second and turn OFF the conveyors.	5
9	PLC BASED CAR PARKING CONTROL SYSTEM* Sequence of Operation: A parking lot allows 10 cars. Sensor 1 senses the incoming car at ENTRY Gate. Sensor 2 senses the outgoing car at the EXIT Gate. Develop and Execute ladder logic in PLC to count the number of cars parked and based on the parking slot available turn ON pilot lamps to Indicate FULL or AVAILABLE. Interface suitable proximity sensors with PLC.	5

10	PLC BASED FAN CONTROL FOR ENERGY CONSERVATION Develop and Execute a ladder logic in PLC to operate Fans in the Meeting Hall based on counting the number of persons entering into the Hall. Interface suitable types of sensor with PLC to sense the person entering into the hall through ENTRY Gate. Interface Low Voltage DC Fan with PLC to check the output. Assume the capacity of the Meeting Hall as 10 or something. • If less than 50% of the hall capacity is filled, turn ON Fan F1 & F2. • If 70 to 80% of the capacity is filled turn ON Fan F1 to F3. • If greater than or equal to 90% of capacity is filled turn ON F1 to F4.	5
11	PLC BASED THREE FLOOR LIFT CONTROL SYSTEM Develop and Execute a ladder logic in PLC to control Lift/Elevator in 3 floor system. Interface Call buttons, suitable sensors for detecting floors and Motor with PLC to check the sequence of operation.	5
Theory Portion:		
UNIT III	**ANALOG I/O MODULE& INDUSTRIAL NETWORK**	Period
Analog Input Modules - Typical Analog Input field devices – Analog Output Modules - Typical analog output field devices. Block diagram of I/O bus networks - Serial communications – Fieldbus Networks - Typical PROFIBUS architecture - Typical MODBUS architecture - Typical Foundation fieldbus architecture – Importance of HMI and SCADA in Automation - Typical SCADA system architecture.		5

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
12.	PLC BASED ILLUMINATION CONTROL SYSTEM. Develop and Execute a ladder logic program for multilevel Illumination control system. • When the potentiometer reaches 25% of its value, turn ON one Lamp in the output to get minimum illumination. • When the potentiometer reaches 50% of its value, turn ON two Lamps in the output to get medium illumination. • When the potentiometer reaches 75% of its value, turn ON three Lamps in the output to get Maximum illumination.	5
	TOTAL PERIODS	**75**

***Note:** Common Test and Revision periods can be used for conducting Continuous Assessment.*

** Exercises No. 4 & 9 is for Demonstration only and Not to be given for Examination. But it must be included in the Practical Document.*

Cycle I Exercises: 1, 2, 3, 5 & 6 and Cycle II Exercises : 7, 8, 10, 11 & 12

Suggested List of Students Activity:

- Activity 1 – PLC Based Mini Project: Four students can be grouped as a batch to do PLC based Mini project. Photograph Evidence to be maintained by faculty as record of activity.
- Activity 2 – Audio or Video Assignment: Ask the students to submit the recorded audio or video of his Technical Explanation or Demonstration on PLC and Automation related topics.
- Activity 3 – Industrial visit to Fully Automated Industry to observe the practical applications of PLC.
- Activity 4: PLC Based Round Table Liquid Filling System: Develop and Execute a ladder logic in PLC to control round table liquid filling system.
- Activity 5: PLC Based Temperature Control System: Develop ladder logic in PLC to control the heating element in the water tank to maintain the temperature between two predetermined limits.

Text and Reference Books:

1. Frank D. Petruzella, Programmable Logic Controllers, 6th Edition, Indian Edition, Mc Graw Hill, 2023
2. Richard A. Cox, Technician's Guide to Programmable Logic Controllers, Fourth Edition, Delmer Cengage Learning, 2013.
3. Gary Dunning , Introduction to Programmable Logic Controllers, Third Edition, Cengage Learning India Pvt Ltd, 2021.
4. Hugh Jack, Automating Manufacturing Systems with PLCs, Free Software Foundation, 2007.
5. L. A. Bryan and E. A. Bryan, "Programmable Controllers Theory and Implementation," 2nd Edition, Industrial Text Company Publication, 1997.

Web-based/Online Resources:

- https://www.sanfoundry.com/100-plc-programming-examples/
- https://archive.nptel.ac.in/courses/108/105/108105062/
- https://www.youtube.com/watch?v=MS3qJq2jvu0
- https://www.youtube.com/watch?v=rqxoREpOjTU

1030235440	PLC AND AUTOMATION	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	PLC with Digital I/O Module	6 Nos
2.	PLC with Analog I/O Module	1 No
3.	PC (or) Laptop installed with PLC Programming Software	7 Nos
4.	DOL Starter Interfacing Kit	1 No
5.	Push Button, Limit Switch, Reed Switch, 3 Wire Proximity Sensor and Buzzer or Pilot Light	Each 1 No
6.	Star Delta Starter Interfacing Kit	1 No
7.	Forward and Reverse Control Interfacing Kit	1 No
8.	Conveyor Arrangement With Siren	1 No
9.	Water Tanks with Float Switch and Solenoid Valve	1 No
10.	Conveyor Arrangement With Proximity Sensor and Buzzer	2 Nos
11.	Car Parking Arrangement with two Sensors and Pilot Light	1 No
12.	Thru beam type Sensor (1No) & DC Fan (4Nos)	1 Set
13.	3 Floor Lift Interfacing Model	1 No
14.	Push Button, Buzzer, Pilot Lights and Connecting cables	As required

<table>
<tr><td>1030235440</td><td rowspan="2">PLC AND AUTOMATION</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>PRACTICUM</td><td>1</td><td>0</td><td>4</td><td>3</td></tr>
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End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Develop and Execute Ladder Logic in PLC for DOL Starter Operation with Single Phasing Prevention.
2. Develop Ladder Logic in PLC to execute the following logical relation between the input and output field devices: a) Y = A + B + C + D b) Y = A . B .C . D c) Y = (A+B) . (C+D) d) Y = (A.B) + (C.D).
3. Develop and Execute Ladder Logic in PLC for Automatic Star- Delta Starter Operation.
4. Develop and Execute Ladder Logic in PLC to delay the start of a conveyor with pre-warning siren.
5. Develop and Execute Ladder Logic in PLC for automatic Water Level Control System using pump motor and solenoid valve.
6. Develop and Execute ladder logic in PLC for counting the object moving in the conveyor.
7. Develop and Execute Ladder Logic in PLC to get the total number of objects transferred by two conveyors into the Plant.
8. Develop and Execute a ladder logic in PLC to operate Fans in the Meeting Hall based on counting the number of persons entering into the Hall.
9. Develop and Execute a ladder logic in PLC to control Lift/Elevator in three floor system.
10. Develop and Execute a ladder logic program for multilevel Illumination control system.

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1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Internet of Things has emerged as an cutting-edge technology with applications in manufacturing, healthcare, Agriculture, transport, mining, smart cities and many more. This subject covers the fundamentals of IoT with its architecture, protocols and Applications. It also covers the overview and programming of the popular IoT platform Raspberry Pi.

Course Objectives:

The objective of this course is to enable the student to

- Learn the fundamental concepts of IoT.
- Learn the Raspberry PI platform that is widely used in IoT applications.
- Practice the Python Scripting Language which is used in many IoT devices.
- Implement web-based services on IoT devices.
- Interface various sensors with Raspberry Pi in IoT applications.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Demonstrate the architecture and functioning of IoT systems.

CO2 : Understand the Python Scripting Language which is used in IoT devices.

CO3 : Understand the working and features of Raspberry Pi.

CO4 : Build a prototype using Raspberry pi.

CO5 : Design an IoT system to take the benefit of the Clouds for computing and storage.

Pre-requisites:

- Sensors and Measurements
- Analog and Digital Electronics
- Programming in C
- Microcontroller and Embedded systems.

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	3	3	2	1	3
CO2	3	1	3	3	2	1	3
CO3	3	1	3	3	2	1	3
CO4	3	1	3	3	2	1	3
CO5	3	1	3	3	2	1	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Program/Circuit, Printout, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Program / Circuit Diagram	15
C	Execution / Connections	10
D	Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Program / Circuit Diagram	20
C	Execution / Connections	20
D	Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**BASICS OF IoT & PYTHON**	Period
Application areas of IoT - Characteristics of IoT - Things in IoT - IoT stack - Enabling technologies - IoT challenges - IoT levels - IoT and cyber physical system - IoT and WSN. Introduction to Python - Language features of Python - Data types - Looping instructions - Control of flow - functions - classes - Exception handling Python packages.		7
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Write a simple Python program to display message on screen.	6
2.	Write a simple Python program using Logical operators.	6
3.	Write a simple Python program to demonstrate use of if else statement.	6
4.	Write a Python program to demonstrate use of ‘while’ loop.	6
5.	Write a Python program to demonstrate use of ‘for’ loop.	6

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:		
UNIT II	**IoT WITH RASPBERRY PI**	Period
Raspberry Pi-Linux on Raspberry Pi-Raspberry Pi Interfaces-Programming Raspberry Pi with Python - Controlling LED/Buzzer with Raspberry Pi -Interfacing an LED and Switch with Raspberry Pi - Interfacing a Light Sensor (LDR) with Raspberry Pi. Introduction to Cloud Storage models and communication APIs Webserver - Web server for IoT - Cloud for IoT - IOT Case studies: smart cities, Industrial IOT.		8
Practical Exercises:		
Ex.No	Name of the Experiment	Period
6.	Install an OS in Raspberry pi.	6
7.	Write a program to blink a LED using raspberry pi.	6
8.	Write and Execute a program for turning a LED ON, when the switch is pressed using raspberry pi.	6
9.	Write a program to control street light automatically using LDR and raspberry pi.	6
10.	Construct an IoT based Air pollution monitoring system.	6
TOTAL PERIODS		**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Activity 1: Students shall practice on their own “Arduino DIY Kits”.
- Activity 2: Mobile based Home automation (IOT) using Raspberry pi.
- Activity 3: Micro project that shall be an extension of any practical lab exercise to real-world application.

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

Text and Reference Books:

1. Simon Monk, Programming the Raspberry Pi: Getting Started with Python, McGraw Hill Professional, January 2012.
2. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), 1st Edition,VPT, 2016.
3. Jain, Prof. Satish, Singh, Shashi, Internet of Things and its Applications, 1st Edition, BPB, 2020.
4. Eben Upton and Gareth Halfacree, “Raspberry Pi User Guide”, 4th edition, John Wiley & Sons., August 2016.
5. Alex Bradbury and Ben Everard, “Learning Python with Raspberry Pi”, John Wiley & Sons., Feb 2014.

Web-based/Online Resources:

- https://archive.nptel.ac.in/courses/106/105/106105166/
- https://www.raspberrypi.com/documentation/computers/getting-started.html
- https://projects.raspberrypi.org/en/collections/python
- https://projects.raspberrypi.org/en/projects/raspberry-pi-getting-started
- https://randomnerdtutorials.com/projects-raspberry-pi/

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment’s	Quantity Required
1.	Desktop Computer	30 Nos
2.	Raspberry Pi Kit with Accessories	6 Nos
3.	Switches, LDR, LEDs and Sensors	As required

1030235541	IoT AND APPLICATION	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Write and Execute a simple Python program to display message on screen.
2. Write and Execute a simple Python program using Logical operators.
3. Write and Execute a simple Python program to demonstrate the use of if else statement.
4. Write and Execute a Python program to demonstrate the use of 'while' loop.
5. Write and Execute a Python program to demonstrate the use of 'for' loop.
6. Perform Installation of an OS in Raspberry pi.
7. Write and Execute a program to blink a LED using raspberry pi.
8. Write and Execute a program for turning a LED ON, when the switch is pressed using raspberry pi.
9. Write and Execute a program to control street light automatically using LDR and raspberry pi.
10. Construct an IoT based Air pollution monitoring system.

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1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Computer hardware and networking form the foundation of modern IT infrastructure, enabling businesses, organizations, and individuals to harness the power of computing technology for various purposes, including productivity, communication, entertainment, and research. Understanding both hardware and networking concepts are essential for anyone working in the field of information technology.

Course Objectives:

The objective of this course is to enable the student to

- Identify various Computer Hardware Components of PC
- Install various secondary storage devices with memory partition, formatting and enable to perform different cable crimping in a network.
- Know the various types of printer installation and perform TCP / IP Configuration.
- Install of Dual OS in a system and perform TCP/IP file transfer.
- Install and configure the networking devices.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Install various secondary storage devices with memory partition and formatting.

CO2 : Install optical storage devices like DVD & Blue Ray disc and perform different cable crimping in a network.

CO3 : Install the printers and configure TCP / IP for network connectivity.

CO4 : Assemble and disassemble laptop to identify the parts and install dual OS in a system.

CO5 : Install and configure networking devices.

Pre-requisites: Basic knowledge of Computers.

1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	-	2	-	-	-
CO2	3	3	-	2	-	-	-
CO3	3	3	-	2	-	-	-
CO4	3	3	-	2	-	-	3
CO5	3	3		2	-		3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies

1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 2 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7^{th} Week	14^{th} Week	15^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Procedure	15
C	Equipment handling & Execution	10
D	Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Procedure	20
C	Equipment handling & Execution	20
D	Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:		
UNIT I	**PC HARDWARE COMPONENTS**	Period
Introduction: Parts - Mother board, sockets, expansion slots, memory, power supply, drives and front panel and rear panel connectors – Hardware, Software and Firmware. Secondary storage: Hard disk – Working principle. Removable Storage: CD & DVD – reading & writing operations - Working of DVD Reader / Writer - Blue-ray – Recording and Playback Principles. Cablings and Standards - Steps for Cable Crimping – Cable Tester. Printers: Introduction – Types of printers – Dot Matrix – Laser – Multi Function Printer- Operation – Features.		8
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Identification of system layout (Study Exercise) a) Front panel indicators & switches and front side & rear side connectors. b) Familiarize the computer system Layout: Marking positions of SMPS, Motherboard, HDD, DVD and add on cards. c) Configure bios setup program and troubleshoot the typical problems using BIOS utility.	5
2.	Hard Disk a) Install Hard Disk. b) Configure CMOS-Setup. c) Partition and Format Hard Disk. d) Identify Master /Slave / IDE Devices. e) Practice with scan disk, disk clean up, disk De-fragmentation, Virus Detecting and Rectifying Software.	5
3.	a) Install and Configure a DVD Writer & Blu-ray Disc Writer. b) Recording a Blank DVD & Blu-ray Disc	5

4.	Do the following cabling works in a network a) Cable Crimpling b) Standard Cabling c) Cross Cabling d) I/O Connector Crimping e) Testing the Crimped cable using a Cable tester.	5
5.	Printer Installation: a) Install and configure Dot matrix printer b) Install and configure Laser printer.	5
Theory Portion:		
UNIT II	**NETWORKING**	
IP Addressing - Dotted Decimal Notation – IP configuration Commands. Displays and Graphic Cards: Panel Displays– Principles of LED, LCD and TFT Displays - SVGA Port signals – common problems and solutions. I/O Ports: Serial – Parallel – USB - Game Port - Bluetooth interface - IR connector - fire ware. Application Layer Protocols – File Transfer Protocol – File Transfer Steps in LAN – Sharing Printer in LAN. Network devices: Features and Concepts of Switches – Routers – Gateways.		7
Practical Exercises:		
Ex.No	Name of the Experiment	Period
6.	a) Configure Host IP, Subnet Mask and Default Gateway in a system in LAN (TCP/IP Configuration). b) Configure Internet connection and use IPCONFIG, PING / Tracert and Netstat utilities to debug the Network issues.	5
7.	Assemble a system with add on cards and check the working condition of the system and install Dual OS.	5
8.	Transfer files between systems in LAN using FTP Configuration. Install a printer in LAN and share it in the network.	5
9.	Install and configure Network Devices: HUB, Switch and Routers.	3

10.	Install and Configure Wired and Wireless NIC and transfer files between systems.	5
Required Practical Instructions for Cycle I & II Experiments		10
TOTAL PERIODS		**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.

Text and References Books:

1. Behrouz A. Forouzan, Data communication and Networking, Fourth Edition, Mc. Graw Hill Higher Education, 2007.
2. William Stallings, Network Security Essentials: Applications and Standards, Fourth Edition, Pearson Publications (Prentice Hall), 2011.
3. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson Publications, 2016
4. Behrouz A.Forouzan, Cyptography and Network Security, Special Indian Edition, Tata McGraw-Hill, 2007.
5. Andrew S.Tanenbaum, David J. Wetherall, Computer Networks, Fifth Edition, Pearson Publications, 2013

Web-based/Online Resources

- http://nptel.ac.in/.
- Vlabs: http://cse29-iiith.vlabs.ac.in/
- https://dgt.gov.in/sites/default/files/CHNM_CTS2.0_NSQF-3.pdf

1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	Desktop Systems	30 Nos
2.	Hard disk drive	6 Nos
3.	DVD, Blu-ray Drive	6 Nos
4.	Blank DVD , Blu-ray Disc	6 Nos
5.	Head Cleaning CD	1 No
6.	Network Cables	50 Mtrs
7.	Crimping Tool & Screw Driver Set	Each 06 Nos
8.	RJ 45 Jack	1 Box
9.	Dot matrix Printer and Laser Printer	Each 1 No
10.	Add on card	6 Nos
11.	Crimping Tool & Screw Driver Set	Each 06 Nos
12.	Switch, Hub and Router	Each 01 No
13.	NIC Card	1 No
14.	Windows / Linux OS Software	-
15.	DVD and Blue Ray Burning S/W	-

1030235542	COMPUTER HARDWARE AND NETWORKING	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Perform following activity on Hard Disk
   a. Install Hard Disk.
   b. Configure CMOS-Setup.
   c. Partition and Format Hard Disk.
   d. Identify Master /Slave / IDE Devices.
   e. Practice with scan disk, disk cleanup, disk De-fragmentation, Virus Detecting and Rectifying Software
2. a. Install and Configure a DVD Writer & Blu-ray Disc Writer.
   b. Recording a Blank DVD & Blu-ray Disc.
3. Do the following cabling works in a network
   a) Cable Crimpling b) Standard Cabling c) Cross Cabling
   d) I/O Connector Crimping e) Testing the Crimped cable using a Cable tester.
4. Install and configure Dot matrix printer and Laser printer.
5. a) Configure Host IP, Subnet Mask and Default Gateway in a system in LAN (TCP/IP Configuration).
   b) Configure Internet connection and use IPCONFIG, PING / Tracert and Netstat utilities to debug the Network issues.
6. Assemble a system with add on cards and check the working condition of the system and install Dual OS.
7. Transfer files between systems in LAN using FTP Configuration. Install a printer in LAN and share it in the network.
8. Install and configure Network Devices: HUB, Switch and Routers.
9. Install and Configure Wired and Wireless NIC and transfer files between systems.

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1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Electrical control of motors and other machinery started with the advent of relays, timers and contactors. The study of relay logic becomes essential for an electrical engineer in order to gain proficiency in the design of control logic. Here construction and working of different types of components and Starters for different types of ac motors are included in this syllabus. The main highlight and interesting part of this course is the explanation of a large number of typical control circuits used in industry. It is hoped that a careful study of these circuits will generate confidence in the students and enhance their confidence in handling such control circuitry employed in industry.

Course Objectives:

The objective of this course is to enable the student to

- Describe the operation of switches, relays, contactor and timers.
- Describe the operation of control and main circuit of AC Motor Starters.
- Understand the concept/principle of various motor controls.
- Understand the operation of motor controls such as two speed control, Forward-Reverse control, Jogging and Dynamic Braking of AC Motor.
- Understand the schematic diagram and design Industrial control circuits.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Familiarize control circuit elements such as industrial switches, relays, timers, contactors, and interlocking arrangements.
CO2	:	Develop and Execute control and main circuit of DOL starter and star delta starter for cage induction motor.
CO3	:	Understand the control and main circuit of Rotor Resistance Starter.
CO4	:	Develop and execute the control and power circuit for Two Speed Control, Forward-Reverse Control, Jogging and Dynamic Braking of ac motor.
CO5	:	Design the industrial control circuits based on the schematic diagram.

Pre-requisites:

- Electrical Machines - I
- Electrical Machines -II.

1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	1	1	2	2
CO2	1	3	3	1	1	3	2
CO3	1	3	3	1	1	3	2
CO4	1	3	3	1	1	3	2
CO5	1	3	3	1	1	3	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	15
C	Connection (Control & Main Circuit)	10
D	Execution and Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Circuit Diagram	20
C	Connections (Control & Main Circuit)	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**COMPONENETS OF CONTROL CIRCUIT**	Period
Switches – Push button and proximity switch - Relays – Frequency response relay and Phase failure relay (single phasing preventer) - Over current relay – Bimetallic thermal over load relay and Magnetic dash pot oil filled relay - Timer – Pneumatic and Electronic timer - Solenoid type contactor (Air break contactor) - Solid state relay - Simple ON-OFF motor control circuit - Remote control Operation and interlocking of drives - Concept and operation of DOL starter and Semi-Automatic and Automatic Star-delta starters.		7
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Wire and test the control and main circuit for DOL starter with OLR.	6
2.	Wire and test the control and main circuit for conveyor motor with detection of metal object stop the conveyor motor for 5 seconds (use proximity sensor and timer).	6
3.	Wire and test the working of single-phasing preventer with control and main circuit.	6
4.	Wire and test the control and main circuit for semi-automatic star – delta starter.	6
5.	Wire and test the control and main circuit for automatic star – delta starter.	6
Theory Portion:		
UNIT II	**MOTOR CONTROL CIRCUITS**	Period
Concept and working /operation of forward and reverse, Jogging, Dynamic braking of cage induction motor and Automatic Rotor Resistance Starting of Slip Ring Induction Motor. Design of control circuit: Planner Machine - Skip hoist control - Conveyor system - Automatic water level control.		8

1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
6.	Wire and test the control and main circuit for two speed pole changing motor.	6
7.	Wire and test the control and main circuit for forward and reverse operation.	6
8.	Wire and test the control and main circuit for jogging in cage induction motor.	6
9.	Wire and test the control and main circuit for dynamic braking of cage motor.	6
10.	Wire and test the control and main circuit for automatic rotor resistance starter.	
TOTAL PERIODS		**75**

Note: **Symbols in the circuit should be used as per Text Book No.01**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes to be conducted on a weekly/fortnightly based on the course.
- Micro project that shall be an extension of any practical lab exercise to real-world application.

Text and Reference Books:

1. S.K. Bhattacharya, Brijinder Singh, Control of Electrical Machines, Revised Second Edition, New Age International Publishers, 2003.
2. Steve Senty, Motor Control Fundamentals, First Edition, Delmar Cengage Learning, 2013.
3. Stephen L. Herman, Electric Motor Control 10^{th} Edition, Delmar Cengage Learning, 2014.

Web-based/Online Resources:

- https://www.youtube.com/watch diploma dote e - lectures

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	AC Contactor 230V/440V, 16A	20 Nos
2.	Push Button With NO/NC Elements	24 Nos
3.	Three Phase Cage Induction Motor (any HP)	5 Nos
4.	Three Phase Slip Ring Induction Motor (any HP)	1 No
5.	Three Phase Two Winding Induction Motor (2 set of Poles)	1 No
6.	Proximity Sensor	1 No
7.	Single Phasing Preventer	1 No
8.	ON Delay Timer	5 Nos
9.	Electronic Timer with Instantaneous and time delay contact	1 No
10.	Multimeter	5 Nos

1030235543	CONTROL OF ELECTRICAL MACHINES	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours | Max. Marks: 100

List of Questions

1. Wire and test the control and main circuit for DOL starter with OLR.
2. Wire and test the control and main circuit for conveyor motor with detection of metal object stop the conveyor motor for 5 seconds (use proximity sensor and timer).
3. Wire and test the working of single-phasing preventer with control and main circuit.
4. Wire and test the control and main circuit for semi-automatic star – delta starter.
5. Wire and test the control and main circuit for automatic star – delta starter.
6. Wire and test the control and main circuit for two speed pole changing motor.
7. Wire and test the control and main circuit for forward and reverse operation.
8. Wire and test the control and main circuit for jogging in cage induction motor.
9. Wire and test the control and main circuit for dynamic braking of cage motor.
10. Wire and test the control and main circuit for automatic rotor resistance starter.

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1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

The Autotronics is referred to as modern automotive technology and also commonly known as Automotive Mechatronics. Autotronics is the combination of automobile and electronics while hybrid refers to technology that uses two or more distinct power sources to move the vehicle. Electronic components and circuits are used to control and monitor the mechanical aspects of a system.

Course Objectives:

The objective of this course is to enable the student to

- Learn the concept of automated drive technology.
- Explain the importance of alternate energy sources.
- Practice in developing prototype of automobile with alternate energy sources.
- Explain the advanced charging and starting, ignition and fuel injection in automobiles.
- Demonstrate the vehicle safety, comfort and Automatic Climate Control in automobiles.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand the operation of sensors and electrical systems in vehicle.

CO2 : Understand automated driving technology.

CO3 : Prepare prototype of solar and wind powered vehicles.

CO4 : Describe advanced charging and Electronic fuel ignition in Automobile.

CO5 : Understand the vehicle safety and automatic climate control in automobiles through technology.

Pre-requisites:

- Basics of Electrical and Electronics
- Sensors
- Digital Skills

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	2	3	-	-
CO2	3	-	3	-	2	1	3
CO3	-	3	2	-	-	3	-
CO4	3	2	2	1	3	3	3
CO5	3	-	2	1	3	-	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Cycle 1 Exercises	Cycle 2 Exercises	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Diagram/Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Diagram and/or Procedure	15
C	Handling of Components	10
D	Execution and Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Diagram and/or Procedure	20
C	Handling of Components	20
D	Execution and Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**INTRODUCTION TO AUTOMATED DRIVING TECHNOLOGIES**	Period
The road to autonomy –Sensor Positioning - Automated Driving System – Mapping.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Online Case studies from Nvidia – Bosch - Google (Waymo) - Tesla Autopilot – Audi - Jaguar Land Rover - Toyota Guardian – FLIR - First sensor AG.	8
Theory Portion :		
UNIT II	**ALTERNATE ENERGY SOURCES**	Period
Overview of Alternate Energy sources in India - Energy and Environment Overview - Importance of Alternate Energy sources.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
2.	Create a prototype of Solar powered vehicle.	14
3.	Create a prototype of Wind powered vehicle.	
Theory Portion :		
UNIT III	**ADVANCED CHARGING AND STARTING, IGNITION AND FUEL INJECTION**	Period
Charging system principles-Smart charging - Advanced Charging system technology-- Electronic starter motor control and stop-start system - Electronic ignition- Electronic control of diesel injection.		4

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
4.	Demonstrate fast charging in an electric vehicle.	16
5.	Dismantling, trouble shooting and assembling of electronic starter motor.	
6.	Trace the automobile electrical system with respect to electronic ignition System.	
7.	Removing, servicing and replacing electronic control of diesel injection.	
Theory Portion :		
UNIT IV	**VEHICLE SAFETY AND COMFORT**	Period
Anti-lock brakes - Automatic transmission - Central locking and child locking.		2
Practical Exercises:		
Ex.No	Name of the Experiment	Period
8.	Demonstrate the working of Antilock braking system.	12
9.	Verify the functionality of individual door lock actuators	
10.	Online Study of the Automatic transmission's shifting behavior under Various driving conditions.	
Theory Portion :		
UNIT V	**AUTOMATIC CLIMATE CONTROL IN CAR**	Period
Automatic Climate Control in Car- difference between Air conditioning and automatic climate control-Saving fuel-Role of sensor in climate control-Importance of Recirculation mode in summer.		3

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
11.	Online case studies of climate control in different manufacturers	10
12.	Dismantle existing AC unit and replace climate control unit in a car and note down the changes in performance.	
TOTAL PERIODS		**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Cycle 1 Exercises for Examination: 2, 3, 4, 5 & 6

Cycle 2 Exercises for Examination: 7, 8, 9 & 12

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course
- Periodic class quizzes conducted on a weekly/fortnightly based on the course
- Viva Voce will be conducted before conducting an experiment.

Text and Reference Books:

1. Konrad Reif, Automotive Mechatronics Automotive Networking · Driving Stability Systems, springer
2. B.T. Fijalkowski, Automotive Mechatronics: Operational and Practical Issues volume 1, Springer
3. Tom Denton, Automated Driving and Driver Assistance Systems, 1st Edition, Routledge, Taylor & Francis Group, UK, 2020.
4. Richard Folkson,Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance, Woodhead Publishing Ltd, 2014.

Web-based/Online Resources:

- https://www.tesla.com/support/autopilot

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

S.No	Name of the Equipment's	Quantity Required
1.	12V Solar Cell	2 Nos
2.	12 V Battery	2 Nos
3.	Multimeter	5 Nos
4.	Prototype Wind Mill	1 No
5.	Fast Charging Kit	1 No
6.	Electronic Starter Motor	1 No
7.	Electronic Ignition Kit	1 No
8.	Electronic control of diesel injection kit	1 No
9.	Antilock Braking kit	1 No
10.	Power door lock actuator	1 No
11.	Automatic climate control kit for car	1 No

1030235544	AUTO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Create a prototype of Solar powered vehicle.
2. Create a prototype of Wind powered vehicle.
3. Demonstrate fast charging in an electric vehicle.
4. Dismantling, trouble shooting and assembling of electronic starter motor.
5. Trace the automobile electrical system with respect to electronic ignition System.
6. Removing, servicing and replacing electronic control of diesel injection.
7. Demonstrate the working of Antilock braking system.
8. Online Study of the Automatic transmission's shifting behavior under Various driving conditions.
9. Verify the functionality of individual door lock actuators
10. Dismantle existing AC unit and replace climate control unit in a car and note down the changes in performance.

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1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Technically, mechanical engineering is the application of the principles and problem-solving techniques of engineering from design to manufacturing to the marketplace for any object. Being ingrained in many challenges and innovations across many fields means a mechanical engineering education is versatile. In this course the students will have fundamental understanding of the Laws of thermodynamics, pressure and temperature measurement, thermal machines, sources of energy, power transmitting elements, various manufacturing processes and engineering materials.

Course Objectives:

The objective of this course is to enable the student to

- Impart knowledge of General Principles of Mechanical Engineering.
- Understand the laws of thermodynamics and Thermodynamic Processes.
- Learn the working Principles of Thermal Machines and Power Plants
- Learn the working Principles of Power Transmitting Devices.
- Learn the Manufacturing Processes and Engineering Materials.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand the fundamental concept of Thermodynamics.
CO2 : Understand the Law of Thermodynamics.
CO3 : Describe the working of Thermal Machines and Power Plants.
CO4 : Understand the principle of Power Transmitting Elements.
CO5 : Understand various Manufacturing Processes and Engineering Materials.

Pre-requisites:

- Knowledge of science and Engineering

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	1	1	-	1	1
CO2	2	1	1	1	-	1	1
CO3	2	1	1	1	-	1	1
CO4	2	1	1	1	-	1	1
CO5	2	1	1	1	-	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 5	Ex. 6 to 10	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Diagram, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Diagram	15
C	Execution	10
D	Output/Result	20
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Diagram	20
C	Execution	20
D	Output/Result	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion :		
UNIT I	**FUNDAMENTALS OF THERMODYNAMICS**	Period
Fundamentals of Thermodynamics, Pressure and Pressure Measurement, Temperature, Zeroth law of Thermodynamics, Thermometric scale, Forms of Energy, Work Transfer, P-dV work, Heat Transfer, Concept of Specific Heat, Sensible Heat, Latent Heat.		3
UNIT II	**FIRST LAW OF THERMODYNAMICS**	Period
First law of Thermodynamics: Law of Conservation of Energy, Joule's experiment, First law for Cyclic and Non-Cyclic processes, Concept of Internal Energy, Enthalpy, Ideal Gases– Concept of Constant Pressure, Constant Volume, Constant Temperature, Adiabatic, Polytropic, Throttling Processes and their representation on p-V and T-s diagrams, Engineering applications of various processes.		3
UNIT III	**INTRODUCTION TO THERMAL MACHINES**	Period
Introduction to Thermal Machines & Sources of Energy: Working principles and application of - Internal Combustion Engines – (2-stroke and 4- stroke engines), Turbines, Compressor, Refrigerator (Description with block diagrams).		3
UNIT IV	**POWER TRANSMITTING ELEMENTS**	Period
Power Transmitting Elements: Working principles and application of – Shaft, Axle and Spindles. Couplings- types of couplings, Friction Clutches, Bearings, Brakes- types of Brakes, Drives – Belt, Chain drives construction, Gears- Classification of Gears.		3

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

UNIT V	MANUFACTURING PROCESSES AND ENGINEERING MATERIALS	Period
Manufacturing Processes and Engineering Materials: Working principles and applications of – Casting, Forging, Welding, Brazing and Soldering. Machining Processes - Turning, Shaping, Milling, Drilling and Grinding, Introduction to Engineering Materials - Ferrous and Non Ferrous.		3
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Study and identification of IC engine components.	60
2.	Study and identification of components of Refrigerator.	
3.	Test on OLP, current coil relay and PTC relay of a refrigeration system.	
4.	Study and Demonstration of working of Brakes, Clutch and Couplings.	
5.	Determination of air flow velocity using anemometer.	
6.	Lathe: Plain Turning	
7.	Lathe: Drilling and Thread Cutting.	
8.	Plain turning using CNC Machines.	
9.	Arc Welding: Lap Joint and Butt Joint	
10.	Arc Welding: Butt Joint	
TOTAL PERIODS		**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Mini project that shall be an extension of any practical lab exercise to real-world application.

Text and References Books:

1. Prof. B.L. Ballaney, Thermal Engineering (Engineering Thermodynamics & Energy Conversion Techniques), 25^{th} Edition, Khanna Publishers.
2. R.K. Rajput, A Textbook of Engineering Thermodynamics, Second Edition, Laxmi Publications Pvt Ltd,. Reprint 2003.
3. S.K. Hajra Choudhary, A.K. Hajra Choudhary, Nirjhar Roy, Elements of Work Shop Technology – Volume I and II, Media Promoters & publishers Pvt.Ltd.
4. V.B. Bhandari, Design of Machine Elements, Fourth Edition, Tata-McGraw Hill Publications, 2017.

Web-based/Online Resources:

- https://phys.libretexts.org/Courses/University_of_California_Davis/UCD%3A_Physics_9B__Waves_Sound_Optics_Thermodynamics_and_Fluids/05%3A_Fundamentals_of_Thermodynamics.
- https://www.energy.gov/energy-sources#:~:text=Primary%20energy%20sources%20take%20many,%2C%20solar%2C%20geothermal%20and%20hydropower.

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	I.C. Engines	1 No
2.	Refrigerator	1 No
3.	Brakes, Clutch, Couplings, Bearings and Gears	Each 3 Nos
4.	Lathe Machines	1 No
5.	Drilling and Threading Machine	1 No
6.	CNC Machine.	1 No
7.	Welding Set	1 No
8.	Anemometer	1 No
9.	OLP, Current coil relay and PTC relay	Each 1 No

1030235545	MECHANICAL ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

End Semester Practical Exam

Model Question Paper

Duration: 3 Hours Max. Marks: 100

List of Questions

1. Identify and label the major components of an internal combustion engine provided in the practical setup and Describe the function of each identified component.

2. Identify and label the key components of a refrigerator provided in the practical setup and Explain the function of each component and its contribution to the refrigeration cycle.

3. Perform tests on the Overload Protector (OLP), Current Coil Relay, and Positive Temperature Coefficient (PTC) Relay as per the provided instructions and Interpret the test results.

4. Demonstrate the working principles of brakes, clutch, and couplings using the provided setups and Explain the operation of each component and discuss its role in power transmission or control in mechanical systems.

5. Use the anemometer to measure the air flow velocity at specified locations and record the measurements accurately and calculate the average air flow velocity.

6. Perform plain turning on a workpiece using a lathe machine. And Ensure precision in the turning process and achieve the specified dimensions of the workpiece.

7. a. Drill holes of specified diameters in the workpiece using the lathe machine.
   b. Perform thread cutting operations on the workpiece as per the provided specifications.

8. a. Operate the CNC machine to perform plain turning on a workpiece.
   b. Program the CNC machine to achieve the desired dimensions and surface finish of the workpiece.

9. Perform arc welding to create lap joints and butt joints as per the provided instructions and Ensure proper fusion and weld quality in the joints.

10. Perform arc welding to create butt joints with specified welding parameters and Inspect the welded joints for defects and ensure weld integrity.

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

In most countries, electrical installations shall comply with more than one set of regulations, issued by National Authorities or by recognized private bodies. It is essential to take into account these local constraints before starting the design. The purpose of these Regulations is to provide guidelines and technical standards that promote the installation of safe and efficient systems of wiring in buildings and other Premises. In estimating, calculation of quantity of material is estimated by the estimator. This course is meant for learning the estimation process by the final semester students.

Course Objectives:

The objective of this course is to enable the student to

- Understand regulations involved in Indian Electricity ACT.
- Familiarize to do the plan lay out using electrical symbols.
- Write down the detailed specification and numbers required of different materials.
- Select size of conductor and prepare list of materials required.
- Understand the electrical safety measures and guidelines.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Explain the regulations involved in Indian Electricity ACT.

CO2 : Prepare the electrical pipe layout for domestic, commercial and industrial building.

CO3 : Estimate the quantity of Electrical materials required for various types of internal wiring.

CO4 : Get familiar about the determination of the size and material of conductor and cable from electrical and mechanical consideration.

CO5 : Familiarize electrical safety measures and guidelines.

Pre-requisites: Knowledge of Electrical Engineering.

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	2	1	-	1	1
CO2	3	1	2	1	-	1	1
CO3	3	1	2	1	-	1	1
CO4	3	2	3	1	-	1	1
CO5	3	2	3	1	-	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Model Practical Examination	Practical Examination
Portion	Ex. 1 to 6	Ex. 7 to 12	All Units	All Exercises	All Exercises
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	60	60	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Drawing, Calculations, Schedule of Materials and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION – Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Pipe Layout & Load Calculation	10
C	Wiring Diagram & Material Calculation	20
D	Schedule of Materials and Approximate Cost	15
TOTAL		50
E	Practical Documents (As per the portions)	10
EXAM MARKS		**60**

- **CA 3:** Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. The question setting details are as follows.

	Description	Pattern	Marks
PART-A	30 Multiple Choice Questions (MCQ)	30 x 1 Mark	30
PART-B	7 Questions to be answered out of 10 Questions	7 x 10 Mark	70
TOTAL MARKS			**100**

- **CA 4:** All the exercises/experiments should be completed and kept for the Model Practical Examination. The students shall be permitted to select any one by lot for the exam. The model practical examination should be conducted as per the End Semester Examination question pattern as given below. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical and End Semester Examination- Practical Exam

Part	Description	Marks
A	Aim & Apparatus Required	05
B	Pipe Layout & Load Calculation	20
C	Wiring Diagram & Material Calculation	20
D	Schedule of Materials and Approximate Cost	25
E	MCQ from Theory Portions	20
F	Viva Voce	10
TOTAL MARKS		**100**

Note: *Practical Document with Bonafide certificate must be submitted to Model Practical Examination and End Semester Practical Examination.*

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:		
UNIT I	**INDIAN ELECTRICITY RULES**	Period
Definitions: Ampere - Apparatus – Accessible - Bare conductor – Cable – Circuit - Circuit Breaker - Conductor Voltage (Low, Medium, High, EH) – Live – Dead - Cut-out – Conduit – System Danger _ Installation - Earthing System – Span – Volt - Switch Gear. IE Rules 1956: 28, 30, 31, 54, 56 & 87 - BEE PAT rules 2012 - Standards and Labelling scheme of BEE.		5
UNIT II	**ELECTRICAL INSTALLATIONS**	Period
Electrical installations, domestics, industrial, Wiring System, Internal distribution of Electrical Energy - Methods of wiring - Systems of wiring - conductor materials used in cables - Types of cables used in internal wiring. ACCESSORIES: Main switch and distribution boards - conduit accessories and fittings - lighting accessories and fittings – fuses - determination of size of fuse wire, fuse units - Earthing - IS specifications regarding earthing of electrical installations - points to be earthed - Determination of size of earth wire and earth plate for domestic and industrial installations - Material required for GI pipe earthing.		5

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Estimate the quantity of material required in Electrical Installation for Small residential building/Flat. (1BHK)	30
2.	Estimate the quantity of material required in Electrical Installation for Computer centre having 10 computers, a/c unit, UPS, light and fan.	
3.	Estimate the quantity of material required in Electrical Installation for Street Light service having 12 lamp light fitting.	
4.	Estimate the quantity of material required in Electrical Installation for Workshop with one number of 3 phase, 15hp induction motor.	
5.	Estimate the quantity of material required in Electrical Installation for Small Workshop with 3 or 4 Machines.	
6.	Estimate the quantity of material required for CCTV wiring with 4 channel DVR for commercial building.	
UNIT III	**ELECTRICAL SAFETY GUIDELINES**	
Electrical Safety in Residential, Commercial and Agricultural Installations: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do’s and Don’ts for safety in the use of domestic electrical appliances - Electrical safety sign and posters. Fire Extinguishers: Fundamentals of fire-initiation of fires, types - extinguishing techniques - prevention of fire - types of fire extinguishers - fire detection and alarm system.		5

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

Practical Exercises: Estimation of Materials using Software		
Ex.No	Name of the Experiment	Period
7.	Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Small residential building/Flat. (1BHK)	30
8.	Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Computer centre having 10 computers, a/c unit, UPS, light and fan.	
9.	Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Street Light service having 12 lamp light fitting.	
10.	Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Workshop with one number of 3 phase, 15hp induction motor.	
11.	Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Small Workshop with 4 Machines.	
12.	Using any supporting Software, Estimate the quantity of material required for CCTV wiring with 4 channel DVR for commercial building.	
TOTAL PERIODS		**75**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.

1030235546	ESTIMATION, STANDARDS AND REGULATIONS	L	T	P	C
PRACTICUM		1	0	4	3

Text and References Books:

1. J.B. Gupta, A course in Electrical Installation, Estimating and costing, 9th Edition, S.K. Kataria and Sons, Reprint 2022.
2. S. Rao, R.K. Jain, Prof. H.L. Saluja, Electrical Safety, Fire Safety Engineering and Safety Management, Second Edition, Khanna Publishers, 2012
3. K.B. Raina & S.K. Battacharya, Electrical Design Estimating and Costing, New age international (P) Ltd, reprint edition 2011.
4. IS 732: Code of Practice for Electrical Wiring Installations

Web-based/Online Resources

- https://cea.nic.in/old/cei_rgn.html
- https://cea.nic.in/cei-regulations/?lang=en
- https://aerc.assam.gov.in/documents-detail/indian-electricity-rule1956
- https://electricity.py.gov.in/indian-electricity-rules
- Bureau of Energy Efficiency: https://beeindia.gov.in

<table>
<tr><td>1030235546</td><td rowspan="2">ESTIMATION, STANDARDS AND REGULATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>PRACTICUM</td><td>1</td><td>0</td><td>4</td><td>3</td></tr>
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End Semester Practical Exam

Model Question Paper

Duration: 3 Hours | Max. Marks: 100

List of Questions

1. Estimate the quantity of material required in Electrical Installation for Small residential building/Flat. (1BHK)
2. Estimate the quantity of material required in Electrical Installation for Computer centre having 10 computers, a/c unit, UPS, light and fan.
3. Estimate the quantity of material required in Electrical Installation for Street Light service having 12 lamp light fitting.
4. Estimate the quantity of material required in Electrical Installation for Workshop with one number of 3 phase, 15hp induction motor.
5. Estimate the quantity of material required in Electrical Installation for Small Workshop with 3 or 4 Machines.
6. Estimate the quantity of material required for CCTV wiring with 4 channel DVR for commercial building.
7. Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Small residential building/Flat. (1BHK)
8. Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Computer centre having 10 computers, a/c unit, UPS, light and fan.
9. Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Street Light service having 12 lamp light fitting.
10. Using any supporting Software, Estimate the quantity of material required in Electrical Installation for Small Workshop with 4 Machines.
11. Using any supporting Software, Estimate the quantity of material required for CCTV wiring with 4 channel DVR for commercial building.

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1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

Introduction:

The integration of Innovation and Start-ups concept within the syllabus is testament to the forward thinking nature of educational institutions. By introducing this concept, students are provided with a solid foundation upon which they can build their skills in Innovation and Start-ups. This course can bridge the gap between theory and practice. It allows students to apply the knowledge they have acquired in a real world context, thereby enhancing their understanding and retention of the above concept. This experimental learning approach not only fosters a deeper level of engagement but also trains student with practical skills necessary to navigate the complexities of the business world. This also empowers students to become an Innovator or Entrepreneur. With necessary tools and knowledge, educational institutions are preparing the next generation of entrepreneurs to tackle the challenges and opportunities that lie ahead. This syllabus will explore the different facets of innovation, including its importance, types and strategies for fostering a culture of innovation within organization.

Course Objectives:

The objective of this course is to enable the student to

- Understand the concept of Innovation and Start-ups.
- Acquire knowledge of Prototype development, IPR, Patents and Copyrights.
- Have Practical experience in preparing Business plan for Start-ups.
- Prepare project report about the present challenges of that industry.
- Know the different funding supports available from Government and Non-Government schemes for Start-ups.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Differentiate between Innovation and Start-ups.

CO2 : Explain the importance of IPR, Patents and Copyrights.

CO3 : Describe the methodology to be adopted for preparing the Business Plan.

CO4 : Gain practical experience by Industrial training and visiting the nearby industry.

CO5 : Explore and identify various funding facilities available from Government and Non-Government Schemes for Start-ups.

1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

Pre-requisites:

There are no specific prerequisites for this course, although a basic understanding of business and technology concepts would be beneficial.

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	1	-	2	3	3
CO2	-	-	1	-	2	3	3
CO3	-	-	1	-	2	3	3
CO4	-	-	1	-	2	3	3
CO5	-	-	1	-	2	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

Assessment Methodology:

	Continuous Assessment (40 Marks)			End Semester Examination (60 Marks)
	CA1	CA2	CA3	
Mode	Theory Test	Seminar Presentation	Submission of Industry Visit Project Report	Practical Examination
Portion	Unit I, II & III	Unit IV	Unit V	Project
Duration	2 Periods	--	--	3 Hours
Exam Marks	50	20	30	100
Converted to	10	10	20	60
Marks	10	10	20	60
Internal Marks	40			60
Tentative Schedule	14th Week	15th Week	16th Week	-

Note:

Continuous Assessment:

S. No	Description	Marks
CA 1	**Class Assessment (50 marks) - Unit – I, II & III** Written Examination - Theory Questions 10 questions out of 15 questions (10 x 3 marks :30 marks) 4 questions out of 6 questions (4 x 5 marks : 20 marks)	10 marks
CA 2	**Seminar Presentations** **(20 marks- each topic carries 10 marks) - Unit IV** Students should present any two topics with PPTs	10 marks
CA 3	Submission of Industry Visit Project Report **(30 marks) - Unit V**	20 marks
Total		**40 marks**

1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

SCHEME OF EVALUATION

End Semester Examination- Practical Exam

Part	Description	Marks
A	Written Examination: Theory question from Unit I, II & III Answer any 10 questions out of given 15 Questions. Each question carries 3 Marks. (10 x 3 = 30 marks)	30
B	Written Examination: Theory question from Unit I, II & III Answer all 3 questions in Either or pattern. Each question carries 5 Marks. (3 x 5=15)	15
C	Presentation of Industry Visit Project Report	25
D	Interaction and Evaluation	30
TOTAL MARKS		**100**

1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

Theory Portion :		
UNIT I	**INTRODUCTION TO INNOVATION**	Period
An Introduction to Innovation and Creativity- Innovation in current Environment - Types of Innovation - Challenges of Innovation - Steps of Innovation Management - Divergent v/s Convergent thinking - Design thinking and Entrepreneurship.		6
UNIT II	**INCUBATION CLUBS, IPR, PATENTS AND COPYRIGHTS**	Period
Idea Generation - Incubation Clubs - Prototype Development - Marketing of Innovation - Management of Innovation - Creation of IPR -Types of IPR - Patents and Copyrights - Patents in India - Technological and Non-Technological Innovation Process.		6
UNIT III	**GOVERNMENT AND NON-GOVERNMENT FUNDING SCHEMES FOR START-UPS**	Period
An introduction to Start-up - Start-ups in India - Procedure for registration of Start-ups - Business Model- Business Plan - Case Studies - Opportunities and Challenges - Funding supports from Government Schemes - MUDRA, TANSEED, NEEDS, PMEGP, UYEGP – Non-Government Schemes - CSR Fund - Angel Investors - Venture Capitalist.		6

1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

UNIT IV	**SEMINAR**	Period
All the students have to select a minimum of 2 topics from the list given below. They are expected to collect the resources with the help of faculty assigned to them to prepare PPTs for presentation. 1. Idea Generation 2. Innovation Management 3. Product Development 4. Business Model Innovation 5. Organizational Culture and Change Management 6. Leadership and Innovation 7. Barriers to Innovation 8. Innovation Marketing 9. E-Commerce success stories (any one) 10. Role of Start-ups in Higher Education 11. Professional Networking in Building Brands 12. How to start a start-up in India		9
UNIT V	**EXPOSURE TO INDUSTRY**	Period
All the students should visit and study the nearby industries, incubation centres, start-ups etc., and select any one to prepare a project report which covers the Name of the Industry/Organization, Introduction of the Industry, Type of the Industry, Scope of the Industry, Plant Layout and Location, Details of Plant and Machineries, Process flow chart, Manufacturing Methods, Process of Manufacturing, Product Manufacturing, Quality Control, Marketing, Product selling – Conclusion.		18
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

1030235654	INNOVATION AND START-UPS	L	T	P	C
PRACTICUM		1	0	2	2

Reference Books:

1. Ina Goller, John Bessant, Creativity for Innovation Management, First Edition, Routledge, 2017.
2. Walter Brenne and Falk Uebernickel , Design Thinking for Innovation, Research and Practice, Springer, 2016.
3. Henri Charmasson, John Buchaca, Patents, Copyrights & Trademarks for Dummies, Second Edition, Wiley Publishing Inc.

Web-based/Online Resources:

- https://www.startupindia.gov.in/
- https://www.mudra.org.in/
- https://startuptn.in/tanseed/
- https://www.msmetamilnadu.tn.gov.in/needs.php
- https://www.kviconline.gov.in/pmegpeportal/pmegphome/index.jsp
- https://msmeonline.tn.gov.in/uyegp/

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1030235773	**INDUSTRIAL TRAINING**	Summer Vacation	C
INTERNSHIP		90 Hours	2

Introduction

Industrial training is a crucial component of the diploma engineering curriculum, designed to bridge the gap between theoretical knowledge and practical application. Typically conducted during vacation periods, this two-week training program provides students with hands-on experience in their respective engineering fields. The primary objectives are to enhance practical skills, familiarize students with industry standards, and prepare them for future employment.

Two-week industrial training during vacation periods is an invaluable part of diploma engineering education. It not only equips students with practical skills but also provides a comprehensive understanding of the industry, preparing them for successful engineering careers.

Objectives

1. Practical Exposure: Students gain direct exposure to real-world engineering practices, tools, and technologies.
2. Skill Enhancement: The training helps in developing technical and soft skills that are essential for professional growth.
3. Industry Insight: Students learn about the working environment, operational procedures, and challenges faced by industries.
4. Professional Networking: The training offers opportunities to interact with industry professionals, which can be beneficial for career prospects.
5. Application of Knowledge: It allows students to apply classroom knowledge to solve practical problems, enhancing their understanding and retention of engineering concepts.

Structure of the Training Program

- Orientation: Introduction to the company, its operations, and safety protocols.
- Project Assignment: Students are assigned specific projects or tasks relevant to their field of study.
- Supervision and Mentorship: Industry professionals guide and mentor students throughout the training.
- Skill Development Workshops: Sessions on technical skills, software tools, and industry best practices.

- Assessment and Feedback: Performance evaluations and constructive feedback to help students improve.

Benefits for Students

- Enhanced Employability: Practical experience makes students more attractive to potential employers.
- Confidence Building: Working in a real-world setting boosts confidence and professional demeanor.
- Clarified Career Goals: Exposure to various roles and responsibilities helps students define their career paths.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Demonstrate proficiency in using industrial machinery, tools, and software.
CO2	:	Able to identify, analyze, and solve engineering problems using industry-standard methods and practices.
CO3	:	Gain a comprehensive understanding of industrial manufacturing processes, quality control, and safety practices.
CO4	:	Exhibit improved communication, teamwork, and professional behavior in an industrial setting.
CO5	:	Apply theoretical concepts learned in their coursework to practical engineering tasks and projects.

Duties Responsibilities of the Faculty Mentor.

One faculty mentor should be assigned for every 30 students by the HOD / Principal. Faculty mentors shall play a crucial role in overseeing and guiding students during their industrial training program in Diploma engineering.

Pre-Training Responsibilities:

1. Orientation and Preparation:
    - Conduct orientation sessions to familiarize students with the objectives, expectations, and guidelines of the industrial training program.

- ○ Assist students in understanding the importance of industrial training in their academic and professional development.

2. Placement Coordination:
    - ○ Collaborate with the placement cell or industry liaison office to secure suitable training placements for students that align with their academic specialization and career interests.
    - ○ Facilitate communication between the institution and host organizations to ensure smooth coordination of training arrangements.
3. Training Plan Development:
    - ○ Help students develop a detailed training plan outlining learning objectives, tasks, and expected outcomes for the training period.
    - ○ Guide students in setting SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals for their training experience.

During Training Responsibilities:

4. Monitoring and Support:
    - ○ Regularly monitor the progress of students during their industrial training. Maintain communication with both students and industry supervisors to track performance and address any issues that may arise.
    - ○ Provide ongoing support and guidance to students, offering advice on technical challenges, professional conduct, and workplace etiquette.
5. Technical Guidance:
    - ○ Offer technical guidance and mentorship related to the specific engineering discipline or specialization of the students. Help them apply theoretical knowledge to practical situations encountered in the industry.
6. Problem-Solving Assistance:
    - ○ Assist students in overcoming obstacles or challenges encountered during their training. Encourage them to develop problem-solving skills and resilience in real-world engineering scenarios.

7. Feedback and Evaluation:
    - ○ Provide constructive feedback on students' performance based on reports, assessments, and observations gathered from industry supervisors.

- Evaluate students' achievements in relation to their training objectives and competencies developed during the program.

Post-Training Responsibilities:

8. Reflection and Debriefing:
   - Conduct debriefing sessions with students to reflect on their training experiences, discuss lessons learned, and identify areas for further improvement.
   - Help students articulate their learning outcomes and how these experiences contribute to their professional growth.
9. Documentation and Reporting:
   - Ensure comprehensive documentation of students' training activities, achievements, and feedback received from industry supervisors.
   - Prepare reports summarizing students' performance and submit these to relevant departments or committees for review and assessment.
10. Career Counseling:
    - Provide career guidance and counseling to students based on their industrial training experiences. Assist them in leveraging these experiences for future job applications or further academic pursuits.
11. Continuous Improvement:
    - Collaborate with industry partners to continuously improve the quality and relevance of the industrial training program.
    - Incorporate feedback from students and industry supervisors to enhance the effectiveness of future training placements.

By fulfilling these duties and responsibilities, faculty mentors contribute significantly to the overall educational experience and professional development of Diploma engineering students during their industrial training program.

1030235773	INDUSTRIAL TRAINING	Summer Vacation	C
INTERNSHIP		90 Hours	2

Instructions to the students

Before Starting Industrial Training:

1. **Orientation and Preparation:**
    - Attend orientation sessions conducted by the institution or faculty mentors to understand the objectives, expectations, and guidelines of the industrial training program.
    - Familiarize yourself with the specific policies, procedures, and safety regulations of the host organization where you will be undergoing training.
2. Setting Goals:
    - Set clear and specific goals for your industrial training period. Define what skills, knowledge, and experiences you aim to gain during this time.
    - Discuss your goals with your faculty mentor and seek their guidance in developing a training plan that aligns with your career aspirations.
3. Professional Attire and Conduct:
    - Dress appropriately and professionally according to the standards of the industry and host organization.
    - Maintain a positive attitude, demonstrate punctuality, and adhere to workplace etiquette and norms.

During Industrial Training:

4. Learning and Engagement:
    - Actively engage in all assigned tasks and projects. Seek opportunities to learn new skills and technologies relevant to your field of study.
    - Take initiative in asking questions, seeking clarification, and participating in discussions with supervisors and colleagues.
5. Adaptability and Flexibility:
    - Adapt to the work environment and demonstrate flexibility in handling various responsibilities and challenges that arise during your training.
    - Be open to different roles and tasks assigned to you, as this will broaden your experience and skill set.
6. Professionalism and Communication:
    - Communicate effectively with supervisors, colleagues, and clients as required. Practice clear and concise verbal and written communication.

- Demonstrate professionalism in all interactions, respecting confidentiality, and adhering to company policies and procedures.

7. Safety and Compliance:
    - Prioritize safety at all times. Familiarize yourself with safety protocols, procedures, and emergency exits in the workplace.
    - Follow all safety guidelines and regulations to ensure your well-being and that of others around you.

After Completing Industrial Training:

8. Reflection and Documentation:
    - Reflect on your training experience. Evaluate what you have learned, the challenges you faced, and how you have grown professionally.
    - Maintain a journal or log documenting your daily activities, achievements, and lessons learned during the training period.
9. Feedback and Evaluation:
    - Seek feedback from your industry supervisor and faculty mentor on your performance and areas for improvement.
    - Use constructive feedback to enhance your skills and competencies for future career opportunities.
10. Career Planning:
    - Use your industrial training experience to inform your career planning and decision-making process.
    - Discuss your career goals and aspirations with your faculty mentor or career counselor for guidance on next steps after completing your diploma.

By following these instructions, Diploma engineering students can make the most of their industrial training experience, gain valuable insights into their chosen field, and prepare themselves effectively for future professional endeavors.

Attendance Certification

Every student has to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution faculty mentor.

1030235773	INDUSTRIAL TRAINING	Summer Vacation	C
INTERNSHIP		90 Hours	2

Training Reports

The students have to prepare reports: The report in the form of a diary to be submitted to the concerned faculty mentor of the institution. This will be reviewed while awarding Internal assessment.

Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

In addition to the diary, students are required to submit a comprehensive report on training with details of the organisation where the training was undergone after attestation by the supervisors. The comprehensive report should incorporate study of plant / product / process / construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training. Any data, drawings etc. should be incorporated with the consent of the Organisation.

Scheme of Evaluation

Internal Assessment

Students should be assessed for 40 Marks by industry supervisor and polytechnic faculty mentor for the Internal Assessment.

Sl. No.	Description	Marks
A	Punctuality and regularity. (Attendance)	10
B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Ability to solve practical problems. Sense of responsibility	10
D	Self expression / communication skills. Interpersonal skills / Human Relation.	10
E	Report and Presentation.	10
Total		50

1030235773	INDUSTRIAL TRAINING	Summer Vacation	C
INTERNSHIP		90 Hours	2

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of industrial training. The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report on Internship, Relevant Internship Certificate from the concerned department.	30
C	Presentation by the student at the end of the Internship.	30
D	Viva Voce	20
Total		100

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Regulation 2023

Diploma in Electrical and Electronics Engineering

VI SEMESTER SYLLABUS

6000236111	ADVANCED ENGINEERING MATHEMATICS	L	T	P	C
THEORY		3	0	0	3

Introduction:

Mathematics is essential for engineering students to understand core engineering subjects. It provides the framework for engineers to solve problems in engineering domains. This course is designed to bridge the gap between diploma mathematics and B.E/B.Tech mathematics in matrix algebra, differential calculus, vector calculus, differential equations, and Laplace transforms.

Course Objectives:

The objective of this course is to enable the student to

- Understand the concepts of Eigen-values and Eigen-vectors of matrices.
- Learn the notation of partial differentiation and determine the extremities of functions of two variables.
- Acquire knowledge in vector calculus which is significantly used to solve engineering problems.
- Formulate and solve differential equations.
- Understand Laplace transformation and its engineering applications.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Find eigenvalues and corresponding eigenvectors of a square matrix.
CO2	:	Apply the knowledge of partial differentiation to evaluate Jacobian and extremities of two variable functions.
CO3	:	Evaluate the gradient of a scalar field and the divergence and curl of vector fields.
CO4	:	Solve ordinary differential equations using various techniques.
CO5	:	Use Laplace transforms to solve first-order ordinary differential equations.

Pre-requisites:

- Knowledge of Matrices, Determinants and Differentiation
- Integration and Vector Algebra.

6000236111	ADVANCED ENGINEERING MATHEMATICS	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	1	1	1	3
CO2	3	3	2	1	1	1	3
CO3	3	3	2	1	1	1	3
CO4	3	3	2	1	1	1	3
CO5	3	3	2	1	1	1	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- A theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-based.
- All demonstrations/Hands-on practices might be under a simulated environment.
- Use inducto-deductive approach to achieve the desired learning objectives.
- Use open-ended questions to nurture the problem-solving and reasoning skills among students.
- Support and guide the students for self-study.
- State the need for mathematics with engineering studies and provide real-life examples.

6000236111	ADVANCED ENGINEERING MATHEMATICS	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6^{th} Week	12^{th} Week	13-14^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

6000236111	ADVANCED ENGINEERING MATHEMATICS	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**EIGENVALUES AND EIGENVECTORS**	Period
Characteristic equation – Eigen-values of 2×2 and 3×3 real matrices – Eigen-vectors of 2×2 real matrices – Properties of eigen-values (excluding proof) – Cayley-Hamilton theorem (excluding proof) – Simple problems.		9
UNIT II	**FUNCTIONS OF SEVERAL VARIABLES**	Period
Partial derivatives of two variable and three variable functions (up to second order) – Homogeneous functions and Euler's theorem (excluding proof) – Jacobian matrix and determinant – Maxima and minima of functions of two variables – Simple problems.		9
UNIT III	**VECTOR CALCULUS**	Period
Scalar filed and Vector field – Vector differential operator – Gradient of a scalar field – Directional derivative – Divergence and curl of a vector field (excluding properties) – Solenoidal and irrotational vector fields – Simple problems.		9
UNIT IV	**DIFFERENTIAL EQUATIONS**	Period
Differential equation – Formation – Order and degree – Solution of a differential equation – Equations of first order and first degree – Variable separable method – Leibnitz's Linear equations – Second order equations of the form $(aD^2 + bD + c)y = e^{nx}$ where a, b, c and n are constants and the auxiliary equation $am^2 + bm + c = 0$ has only real roots) – Complementary function – Particular integral – General solution – Simple problems.		9

6000236111	ADVANCED ENGINEERING MATHEMATICS	L	T	P	C
THEORY		3	0	0	3

UNIT V	**LAPLACE TRANSFORMS**	Period
Definition of Laplace transform – Laplace transforms of standard functions - Linearity and change of scale property (excluding proofs) – First shifting property – Laplace transforms of derivatives – Properties (excluding proofs) – Inverse Laplace transforms – Properties (excluding proofs) – Solving first order ordinary differential equation using Laplace transforms – Simple problems.		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Demonstrate the applications of eigen-values in stability analysis, decouple of three-phase systems and vibration analysis.
- Demonstrate maxima and minima of two variable functions using GeoGebra graphing calculator.
- Demonstrate solenoidal vector field and irrotational vector field using engineering applications.
- Demonstrate the applications of differential equations in solving engineering problems.
- Presentation /Seminars by students and conduct Quizzes.

Text and Reference Books:

1. John Bird, Higher Engineering Mathematics, 9th Edition, Routledge, 2021.
2. B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, 2012.
3. S. Arumugam, A. Thangapandi Isaac, & A. Somasundaram, Differential Equations and Applications, Yes Dee Publishing Pvt. Ltd., 2020.
4. P. Duraipandian, & Kayalal Pachaiyappa, Vector Analysis, S Chand and Company Limited, 2014.
5. S. Narayanan, & T.K. Manicavachagom Pillai, Calculus Volume I and II, S. Viswanathan Publishers Pvt. Ltd., 2007

Web-based/Online Resources:

- https://www.khanacademy.org/math/
- https://www.mathportal.org/
- https://openstax.org/subjects/math
- https://www.mathhelp.com/
- https://www.geogebra.org/
- https://www.desmos.com/
- https://phet.colorado.edu/

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6000236112	ENTREPRENEURSHIP	L	T	P	C
THEORY		3	0	0	3

Introduction:

Development of a diploma curriculum is a dynamic process responsive to the society and reflecting the needs and aspiration of its learners. Fast changing society deserves changes in educational curriculum particularly to establish relevance to emerging socio-economic environments; to ensure equity of opportunity and participation and finally promoting concern for excellence. In this context the course on entrepreneurship and start ups aims at instilling and stimulating human urge for excellence by realizing individual potential for generating and putting to use the inputs, relevant to social prosperity and thereby ensure good means of living for every individual, provides jobs and develop Indian economy.

Course Objectives:

The objective of this course is to enable the student to

- Acquire entrepreneurial spirit and resourcefulness.
- Familiarize Acquire knowledge about the business idea and product selection.
- Analyze the banking and financial institutions.
- Understand the pricing policy and cost analysis.
- Get knowledge about the business plan preparation.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand the process of entrepreneurship.
CO2 : Analyse the importance of generation of ideas and product selection.
CO3 : Familiarization of various financial and non financial schemes.
CO4 : Acquire various cost components to arrive pricing of the product.
CO5 : Learn the preparation of project feasibility report.

Pre-requisites:

- Knowledge of basic Engineering and Industrial engineering.

6000236112	ENTREPRENEURSHIP	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	-	-	-	-	3	1	3
CO2	-	-	-	-	3	3	3
CO3	-	-	-	1	-	3	2
CO4	-	1	3	3	2	3	2
CO5	-	2	3	3	3	3	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.

6000236112	ENTREPRENEURSHIP	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

6000236112	ENTREPRENEURSHIP	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**ENTREPRENEURSHIP – INTRODUCTION AND PROCESS**	Period
Concept of entrepreneurship - Importance, Myths about Entrepreneurship, Pros and Cons of Entrepreneurship, Process of Entrepreneurship, Competencies and characteristics of an entrepreneur - Ethical Entrepreneurship, Entrepreneurial Values and Attitudes, Creativity, Innovation and entrepreneurship - Entrepreneurs - as problem solvers, Mindset of an employee and an entrepreneur - Risk Taking – Concepts.		9
UNIT II	**BUSINESS IDEA**	Period
Types of Business: Manufacturing, Trading and Services, Stakeholders: sellers, vendors and consumers and Competitors, E- commerce Business Models, business idea generation - Types of Resources - Human, Capital and Entrepreneurial tools and resources, etc., - setting business goals - Patent, copyright and Intellectual property rights, Customer Relations and Vendor Management - Business Ideas vs. Business Opportunities, Opportunity – SWOT ANALYSIS of a business idea - Business Failure – causes and remedies - Types of business risks.		9
UNIT III	**BANKING**	Period
Size and capital based classification of business enterprises - Role of financial institutions, Role of Government policy, Entrepreneurial support systems, Incentive schemes for state government, and Incentive schemes for Central governments.		9
UNIT IV	**PRICING AND COST ANALYSIS**	Period
Types of Costs - Variable – Fixed - Operational Costs - Break Even Analysis - for single product or service - financial Business Case Study, Understand the meaning and concept of the term Cash Inflow and Cash Outflow – Pricing - Calculate Per Unit Cost of a single product, Understand the importance and preparation of Income Statement, Prepare a Cash Flow Projection - Factors affecting pricing - GST.		9

6000236112	ENTREPRENEURSHIP	L	T	P	C
THEORY		3	0	0	3

UNIT V	BUSINESS PLAN PREPARATION	Period
Feasibility Report – Technical analysis, financial analysis- Market Research - Concept, Importance and Process- tools for market research- Market Sensing and Testing, Marketing and Sales strategy, Digital marketing, Branding - Business name, logo, tag line, Promotion strategy, Business Plan Preparation, -Concept and Importance, , Execution of Business Plan.		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

1. Students can explore app development or web design. They'll learn about technology, user experience, and marketing.
2. Hosting events, workshops, or conferences allows students to practice project management, networking, and marketing skills.
3. Encourage students to address social or environmental issues through innovative business solutions. This fosters empathy and creativity.
4. Part of entrepreneurship clubs or organizations provides networking opportunities, mentorship, and exposure to real-world challenges.
5. Competitions like business plan contests or pitch events allow students to showcase their ideas and receive feedback.
6. Students can create and sell handmade crafts, artwork, or other products. This teaches them about production, pricing, and customer relations.
7. Students can provide consulting services in areas they're knowledgeable about, such as social media marketing or financial planning.
8. Encourage students to create and manage their own small business or offer freelance services. This hands-on experience helps them understand various aspects of entrepreneurship.

Text and Reference Books:

6000236112	ENTREPRENEURSHIP	L	T	P	C
THEORY		3	0	0	3

1. Dr. G.K. Varshney, Fundamentals of Entrepreneurship, Revised Edition, Sahitya Bhawan Publications, 2019.
2. H.Nandan, Fundamentals of Entrepreneurship, Prentice Hall India Learning Private Limited, Third Edition, 2013.
3. R.K. Singal, Entrepreneurship Development & Management, S K Kataria and Sons, 2013.

Web-based/Online Resources:

- https://ocw.mit.edu/courses/15-390-new-enterprises-spring-2013/resources/lecture-1/
- https://onlinecourses.nptel.ac.in/noc20_ge08/preview

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6000236113	PROJECT MANAGEMENT	L	T	P	C
THEORY		3	0	0	3

Introduction:

Project management is the systematic application of knowledge, skills, tools, and techniques to project activities to meet specific project requirements. It involves planning, organizing, and managing resources to achieve project goals within defined scope, time, and budget constraints. Project management encompasses several key processes and phases, including initiation, planning, execution, monitoring and controlling, and closing. It is essential across various industries to ensure projects are completed successfully, efficiently, and effectively, aligning with organizational objectives and stakeholder expectations. Project managers play a crucial role in leading teams, managing risks, ensuring quality, and communicating with stakeholders to drive project success.

Course Objectives:

The objective of this course is to enable the student to

- Understand the concept, characteristics and elements of projects.
- Understand the stages in Project Life Cycle.
- Appreciate the need for Project Portfolio Management System.
- Know the considerations in choosing appropriate project management structure.
- Understand the components of techno-economic feasibility studies.
- Know about the detailed project report
- Learn about project constraints.
- Understand the techniques of evaluation.
- Get insight into the Social Cost Benefit Analysis Method.
- Know how to construct project networks using PERT and CPM.
- Learn how to crash project networks
- Understand the meaning of project appraisal.
- Understand the meaning of project audits.
- Know the qualities of an effective project manager.
- Understand the stages in Team Development model.

6000236113	PROJECT MANAGEMENT	L	T	P	C
THEORY		3	0	0	3

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Understand the Project Management Principles.

CO2 : Learn to create and manage project schedules.

CO3 : Create structure and manage the project commitments.

CO4 : Gain enterprise support.

CO5 : Prepare Detailed Project Report (DPR).

Pre-requisites:

- Knowledge of basic Engineering

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	-	3	1
CO2	3	-	-	-	1	3	1
CO3	3	-	-	1	1	3	1
CO4	3	-	-	-	1	3	1
CO5	3	-	-	1	1	3	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.

6000236113	PROJECT MANAGEMENT	L	T	P	C
THEORY		3	0	0	3

- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

6000236113	PROJECT MANAGEMENT	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**PROJECT MANAGEMENT – AN OVERVIEW, PROJECT PORTFOLIO MANAGEMENT SYSTEM AND STRUCTURE, STEPS IN DEFINING PROJECT AND PROJECT DELAYS**	Period
Project – Classification – Importance of Project Management – An Integrated Approach – Project Portfolio Management System – The Need – Choosing the appropriate Project Management Structure: Organizational considerations and project considerations – steps in defining the project – project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints.		9
UNIT II	**VARIOUS STAGES AND COMPONENTS OF PROJECT FEASIBILITY STUDIES, PHASES OF A PROJECT, STAGES IN PROJECT LIFE CYCLE AND PROJECT CONSTRAINTS**	Period
Project feasibility studies - Opportunity studies, General opportunity studies, specific opportunity studies, pre-feasibility studies, functional studies or support studies, feasibility study – components of project feasibility studies – Managing Project resources flow – project planning to project completion: Pre-investment phase, Investment Phase and operational phase – Project Life Cycle – Project constraints.		9
UNIT III	**PROJECT EVALUATION UNDER CERTAINTY AND UNCERTAINTY, PROJECT EVALUATION, COMMERCIAL AND SOCIAL COST BENEFIT ANALYSIS**	Period
Project Evaluation under certainty - Net Present Value (Problems - Case Study), Benefit Cost Ratio, Internal Rate of Return, Urgency, Payback Period, ARR – Project Evaluation under uncertainty – Methodology for project evaluation – Commercial vs. National Profitability – Social Cost Benefit Analysis, Commercial or National Profitability, social or national profitability.		9

UNIT IV	**DEVELOPING PROJECT NETWORK USING PERT AND CPM, PROJECT APPRAISAL AND CONTROL PROCESS.**	Period
Developing a Project Plan - Developing the Project Network – Constructing a Project Network (Problems) – PERT – CPM – Crashing of Project Network (Problems - Case Study) – Resource Leveling and Resource Allocation – how to avoid cost and time overruns – Steps in Project Appraisal Process – Project Control Process – Control Issues – Project Audits – the Project Audit Process – project closure – team, team member and project manager evaluations.		9
UNIT V	**PROJECT MANAGING VERSUS LEADING OF PROJECT, QUALITIES OF PROJECT MANAGER AND MANAGING PROJECT TEAMS, TEAM BUILDING MODELS AND PERFORMANCE TEAMS AND TEAM PITFALLS.**	Period
Managing versus leading a project - managing project stakeholders – social network building (Including management by wandering around) – qualities of an effective project manager – managing project teams – Five Stage Team Development Model – Situational factors affecting team development – project team pitfalls.		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

Project Simulation and Role-Playing:

- Activity: Participate in simulated project scenarios where students take on different roles within a project team (e.g., project manager, team member, stakeholder).
- Purpose: This helps students understand the dynamics of project management, including leadership, communication, and team collaboration.

Case Study Analysis:

- Activity: Analyze real-world case studies of successful and failed projects.
- Purpose: This activity enables students to apply theoretical knowledge to practical situations, identify best practices, and learn from the challenges and solutions implemented in real projects.

Project Plan Development:

- Activity: Develop a comprehensive project plan for a hypothetical or real project, including scope, schedule, budget, risk management, and quality management plans.
- Purpose: This allows students to practice creating detailed and structured project plans, honing their skills in planning and organizing project activities.

Group Project:

- Activity: Work in teams to manage a project from initiation to closure, simulating a real project environment.
- Purpose: Group projects help students learn how to work collaboratively, manage group dynamics, and apply project management tools and techniques in a team setting.

Project Management Software Training:

- Activity: Gain hands-on experience with project management software such as Microsoft Project, Asana, or Trello.
- Purpose: This activity equips students with practical skills in using technology to plan, track, and manage project tasks and resources efficiently.

6000236113	PROJECT MANAGEMENT	L	T	P	C
THEORY		3	0	0	3

Text and Reference Books:

1. Clifford F. Gray And Erik W. Larson, Project Management – The Managerial Process, Tata Mcgraw Hill.
2. Dragan Z. Milosevic, Project Management Toolbox: Tools And Techniques For The Practicing Project Manager,
3. Gopalakrishnan, P/ Ramamoorthy, V E, Textbook Of Project Management, Macmillan India. Ltd.
4. Harold Kerzner, Project Management: A Systems Approach To Planning, Scheduling, And Controlling, Eighth Edition, John Wiley & Sons
5. Jason Charvat, Project Management Methodologies: Selecting, Implementing, And Supporting Methodologies And Processes For Projects, John Wiley & Sons
6. Kevin Forsberg, Ph.D, Hal Mooz, Visualizing Project Management: A Model For Business And Technical Success, Second Edition, Pmp And Howard Cotterman, John Wiley & Sons

Web-based/Online Resources:

- https://youtu.be/pc9nvBsXsuM
- NPTEL Courses
- https://youtu.be/PqQqTAu_FiM

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6000236114	FINANCE FUNDAMENTALS	L	T	P	C
THEORY		3	0	0	3

Introduction:

This course gives a deep insight into the finance fundamentals such as money management and the process of acquiring needed funds. It also encompasses the oversight, creation, and study of money, banking, credit, investments, assets, liabilities that make up financial systems and improves overall financial literacy.

Course Objectives:

The objective of this course is to enable the student to

- Identify different ways to save money for future
- Understand various techniques to raise capital
- Get acquainted with the essential terminologies used in finance language
- Get exposed to different types of budgeting
- Instil the concept of costing and its impact on profitability.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Manage financial resources effectively to achieve personal goals.
CO2	:	Ensure that the business has enough money to meet its obligations and that it can recover in the future.
CO3	:	Exhibit financial literacy through the usage of different terminologies appropriate to the context.
CO4	:	Differentiate different types of budgeting and allocate the resources.
CO5	:	Apply the idea of marginal costing in decision making.

Pre-requisites:

- Knowledge of basic Industries.

6000236114	FINANCE FUNDAMENTALS	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	-	-	-	1	-	2
CO2	3	-	-	-	1	-	2
CO3	3	-	-	-	1	-	2
CO4	3	-	-	-	1	-	2
CO5	2	-	-	-	1	-	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.

6000236114	FINANCE FUNDAMENTALS	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

6000236114	FINANCE FUNDAMENTALS	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**PERSONAL FINANCE**	Period
Personal Finance – Meaning, Objectives and advantages – Individual Perspective – Family Perspective – Time Value of Money – Personal Savings: Meaning, Different modes of Saving – Bank Deposit, Online Investments, Insurance, Stocks, Gold, Real Estate – Returns Vs Risk – Financial Discipline – Setting Alerts for commitments (With Real time Examples).		9
UNIT II	**BUSINESS FUNDING**	Period
Sources: Personal Savings – Borrowings – Venture Capital – Venture Capital Process – Commercial Banks – Government Grants and Scheme.		9
UNIT III	**FINANCE LANGUAGE**	Period
Capital – Drawing – Income – Expenditure – Revenue Vs Capital Items – Assets – Fixed Assets – Current Assets – Fictitious Assets – Liabilities – Long-term Liabilities – Current Liabilities – Internal Liabilities – External Liabilities – Share holders fund: Equity Share capital, Preference Share Capital, Reserve & Surplus – Borrowings: Debentures, Bank Loan, Other Loan – Depreciation – Reserve Vs Provision.		9
UNIT IV	**BUDGETING**	Period
Budgetary Control – Meaning – Preparation of various budgets – Purchase budget – Sales Budget – Production budget – Cash Budget – Flexible budgets.		9
UNIT V	**MARGINAL COSTING**	Period
Marginal Costing – Meaning – Marginal Costing Vs Absorption Costing – Concepts of Variable Cost, Fixed Cost and Contribution – PV Ratio – Break Even Point – Margin of Safety – Key Factor – Application of Marginal Costing in decision making – Make or Buy – Shutdown or Continue – Exploring New Markets (With Problems).		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

6000236114	FINANCE FUNDAMENTALS	L	T	P	C
THEORY		3	0	0	3

Suggested List of Students Activity:

Financial Statement Analysis:

- Activity: Analyze and interpret financial statements, including balance sheets, income statements, and cash flow statements of different companies.
- Purpose: This activity helps students understand the financial health and performance of organizations, developing skills in financial analysis and critical thinking.

Investment Portfolio Management:

- Activity: Create and manage a simulated investment portfolio, making decisions on asset allocation, stock selection, and diversification.
- Purpose: This allows students to apply theoretical concepts in a practical setting, learning how to evaluate investment opportunities and manage financial risk.

Case Study Analysis:

- Activity: Examine real-world case studies involving financial decisions made by companies, such as capital budgeting, mergers and acquisitions, and financial restructuring.
- Purpose: Case studies provide insights into the application of finance principles in business scenarios, enhancing problem-solving and decision-making skills.

Financial Modeling:

- Activity: Build financial models using spreadsheets to forecast future financial performance, conduct sensitivity analysis, and evaluate business projects.
- Purpose: Financial modeling is a critical skill in finance, enabling students to project financial outcomes and support strategic decision-making with quantitative analysis.

Classroom Discussions and Debates:

- Activity: Participate in discussions and debates on current financial issues, market trends, and economic policies.
- Purpose: Engaging in discussions helps students stay informed about the latest developments in finance, develop their communication skills, and form well-rounded opinions on financial matters

6000236114	FINANCE FUNDAMENTALS	L	T	P	C
THEORY		3	0	0	3

Reference Books:

1. Dr. L. Natarajan, Banking Theory, Law & Practice, First Edition, Margham Publications, 2019.
2. T.S.Reddy and Dr. A.Murthy , Corporate Accounting, Margham Publications.
3. T.S. Reddy & Dr. Y. Hariprasad Reddy, Management Accounting, Margham Publications.
4. T.S.Reddy and Y. Hariprasad Reddy, Cost Accounting, Margham Publications.

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1030236115	INDUSTRIAL MANAGEMENT AND SAFETY	L	T	P	C
THEORY		3	0	0	3

Introduction:

A safety management system (SMS) is defined as an organization-wide process designed to manage safety risk in the workplace. A safety management system can be created to fit any business type and/or industry sector. Industrial safety in the context of occupational safety and health refers to the management of all operations and events within an industry, for protecting its employees and assets by minimizing hazards, risks, accidents and near misses. The relevant laws, compliance and best practices in the industry have most of the issues addressed for the best protection possible. Employers are to make sure that these are strictly adhered to have maximum safety.

Course Objectives:

The objective of this course is to enable the student to

- Ensure protection of worker's rights and to redress their grievances.
- Prevent not only the major industrial accidents.
- Prevent the accidents causing permanent or partial disablement.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
CO2	:	Summarize the Safety aspects during Installation of Plant and Equipment.
CO3	:	Describe the electrical safety in residential, commercial and agricultural installations.
CO4	:	Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.
CO5	:	State the electrical systems safety management and IE rules.

Pre-requisites:

- Knowledge of basic Industries and Safety systems.

1030236115	INDUSTRIAL MANAGEMENT AND SAFETY	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	-	-	2
CO2	3	2	1	1	-	-	2
CO3	3	2	1	1	-	-	2
CO4	3	2	-	1	-	-	2
CO5	2	2	-	2	2	-	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030236115	INDUSTRIAL MANAGEMENT AND SAFETY	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

  The question setting details are as follows.

  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236115	INDUSTRIAL MANAGEMENT AND SAFETY	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION**	Period
Terms and definitions - Objectives of safety and security measures - Hazards associated with electric current and voltage - Principles of electrical safety - Approaches to prevent Accidents - Scope of subject electrical safety. Primary and secondary electrical shocks - possibilities of getting electrical shock and its severity - medical analysis of electric shocks and its effects - shocks due to flash/ Spark over's - prevention of shocks - safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.		9
UNIT II	**SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT**	Period
Introduction - preliminary preparations - preconditions for start of installation work - risks during installation of electrical plant and equipment - safety aspects during installation - field quality and safety during erection- personal protective equipment for erection personnel - installation of a large oil immersed power transformer - installation of outdoor switchyard equipment - safety during installation of electrical rotating machines - drying out and insulation resistance measurement of rotating machines.		9
UNIT III	**ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL**	Period
Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.		9

UNIT IV	EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING	Period
Introduction - Distinction between system grounding and Equipment Grounding - Equipment Earthing - Functional Requirement of earthing system - description of a earthing system. Neutral grounding (System Grounding) - Types of Grounding, Methods of Earthing Generators Neutrals.		9
UNIT V	**SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS & IE RULES AND ACTS**	Period
SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Management Safety Policy - Safety organization - safety auditing - Motivation to managers, Supervisors and Employees. REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – Rules regarding first aid and fire fighting facility - The Electricity Act, 2003, (Part 1, 2, 3,4 & 5)		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Mini project that shall be an extension of any practical lab exercise to real-world application.

1030236115	**INDUSTRIAL MANAGEMENT AND SAFETY**	L	T	P	C
THEORY		3	0	0	3

Text and Reference Books:

1. Prof. S. Rao, H.L. Saluja, Electrical safety, fire safety Engineering and safety management, Khanna Publishers, 1997.
2. Pradeep Chaturvedi, Energy management policy, planning and utilization, Concept Publishing company, 1997.

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1030236116	BATTERY MANAGEMENT SYSTEM	L	T	P	C
THEORY		3	0	0	3

Introduction:

Battery management system (BMS) is technology dedicated to the oversight of a battery pack, which is an assembly of battery cells, electrically organized in a row x column matrix configuration to enable delivery of targeted range of voltage and current for a duration of time against expected load scenarios. Energy storage systems play a crucial role in enhancing the stability, reliability, and flexibility of electrical grids by providing a buffer that can balance energy supply and demand. They can store energy in various forms, such as electrical, mechanical, chemical, or thermal, and release it when needed.

Course Objectives:

The objective of this course is to enable the student to

- Understand the different types of energy storage system.
- Study about the battery characteristic & parameters.
- Model the types of batteries.
- Know the concepts of battery management system and design the battery.
- Study about the battery testing, disposal and recycling.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Discuss about the different types of energy storage system.
CO2	:	Describe about the battery characteristic & parameters.
CO3	:	Model different types of batteries.
CO4	:	Apply the concepts of battery management system and design the battery pack.
CO5	:	Explain about the battery testing, disposal and recycling.

Pre-requisites:

- Basics of Science
- Basics of Batteries

1030236116	BATTERY MANAGEMENT SYSTEM	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	-	1	-	-	2
CO2	3	2	1	1	-	-	2
CO3	3	2	1	1	-	-	2
CO4	3	2	-	1	-	-	2
CO5	2	2	-	2	2	-	3

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030236116	BATTERY MANAGEMENT SYSTEM	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.

  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236116	BATTERY MANAGEMENT SYSTEM	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**INTRODUCTION TO BATTERY MANAGEMENT SYSTEM**	Period
	Definition of Battery Management System – Block Diagram of Battery Management System - Battery Management System parts – Why a BMS is required in any Energy storage system – PLC based BMS – Safety Management: Over current protection – Over charge and over discharge protection – Over temperature protection – Topological relationship between a Battery Monitoring Circuit (BMC) and a cell - Topological relationship between a Battery Monitoring Circuit (BMC) and a Battery Control Unit (BCU) - The benefits of battery management systems.	9
UNIT II	**ENERGY STORAGE SYSTEM**	Period
	Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery - Ultra capacitors - Flywheel Energy Storage System - Hydraulic Energy Storage System - Comparison of different Energy Storage System.	9
UNIT III	**BATTERY PARAMETERS & CHARGING**	Period
	General definitions: Cell and Battery – Energy Density – Power Density – Rated Capacity - Specific Energy - Specific Power - Efficiency of batteries - State of Charge (SOC) - C-rate - State of Health (SOH) - Cycle Life - Cut-off voltage - Self-Discharge - Nominal Voltage. Charging modes: Low rate charging – Quick charging – Fast Charging - Top-off or equalization charging - Trickle or maintenance charging - Reflex or 'burp' charging. End-of-charge triggers: Timed end-of-charge trigger - Maximum temperature end-of-charge trigger - Maximum voltage end-of-charge trigger.	9

1030236116	BATTERY MANAGEMENT SYSTEM	L	T	P	C
THEORY		3	0	0	3

UNIT IV	EV BATTERY EFFICIENCY	Period
Factors affecting battery efficiency - Regenerative Braking - Variation of battery cell voltage during early formation cycles - Battery failure modes due to operating conditions - Failure modes associated with excessive battery charging - Failure modes associated with inadequate battery charging - Failure modes associated with battery storage conditions - Self discharge of NiMH battery stored at 100% SOC - Traction Battery Pack Design – General approach of Battery modelling.		9
UNIT V	**BATTERY TESTING, DISPOSAL & RECYCLING**	Period
Battery Testing: Constant current discharge test – Peak Power Test - Constant Power Test - Variable Power Discharge Test - Partial Discharge Test - Standloss Test - Thermal Performance Test - Battery Vibration Test - Fast Charge Test. Limitations for transport and storage of cells and batteries – Battery Leakage: gas generation in batteries, leakage path, leakage rates - Explosions: Causes of battery explosions, explosive process - Thermal Runway: High discharge rates, Short circuits, charging and discharging - Environment and Human Health impact assessments of batteries - General recycling issues and drivers - methods of recycling of EV batteries.		9
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Mini project that shall be an extension of any practical lab exercise to real-world application

1030236116	BATTERY MANAGEMENT SYSTEM	L	T	P	C
THEORY		3	0	0	3

Text and Reference Books:

1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, Thermal Management of Electric Vehicle Battery Systems, First Edition, John Wiley& Sons Ltd., 2016.
2. H.J. Bergveld, Wanda S. Kruijt and Peter P.H.L. Notten, Battery Management Systems Design by Modelling, Springer Science Business Media, 2001.
3. Sandeep Dhameja, Electric Vehicle battery systems, Newnes, 2001.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

Web-based/Online Resources:

- https://mnre.gov.in/energy-storage-systemsess-overview/

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1030236117	INDUSTRIAL AUTOMATION	L	T	P	C
THEORY		3	0	0	3

Introduction:

Industrial automation can make production lines safe and uses logic-based programs to operate machinery and other industrial equipment technologies. Industrial automation offers a number of benefits over traditional manual labour. Automated facilities can work faster and more accurately than human workers, and they can operate around the clock without tiring and can collect data for monitoring the health status of the equipment and reduce waste. Automation can also help to improve safety in hazardous environments.

Course Objectives:

The objective of this course is to enable the students to

- Impart the basic knowledge in automation of industrial processes.
- Learn the different automated flow lines in manufacturing industries.
- Explore the material handling and part identification techniques.
- Learn about control system, assembly system and testing in modern manufacturing industries

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Understand the basics of automation and analyze the cost effective of automated system.
CO2	:	Identify the suitable flow lines and understand the computer simulation for the automation of given application.
CO3	:	Describe material handling and relevant technologies for the automation.
CO4	:	Differentiate various control aspects of automation.
CO5	:	Demonstrate the automation for assembly line and testing of manufacturing industry.

Pre-requisites: Basic Electrical and Electronics Engineering.

1030236117	INDUSTRIAL AUTOMATION	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	2	-	1	1
CO2	3	2	2	2	-	1	1
CO3	3	2	2	2	-	1	1
CO4	3	2	2	2	-	1	1
CO5	3	2	2	2	-	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030236117	INDUSTRIAL AUTOMATION	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test	Written Test	Quiz (Online/ Offline)	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Units	All Units	All Units
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	05	20	60
Marks	15		05	20	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 15 Marks. Best of one will be considered for the internal assessment of 15 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.

- **CA3:** 60 Multiple Choice Questions (MCQ) can be asked by covering the entire portion. It may be conducted by Online / Offline mode. The marks scored should be converted to 5 marks for the internal assessment. The answer scripts of every student (online / offline) for this assessment should be kept for records and future verification.

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236117	INDUSTRIAL AUTOMATION	L	T	P	C
THEORY		3	0	0	3

Theory Portion :		
UNIT I	**INTRODUCTION TO AUTOMATION**	Period
Automation in Production System - Principles and Strategies of Automation - Basic Elements of an Automated System - Advanced Automation Functions -Levels of Automations - Production Economics: Methods of Evaluating Investment Alternatives - Costs in Manufacturing - Break Even Analysis - Unit cost of production - Cost of Manufacturing Lead time and Work-in-process.		7
UNIT II	**DETROIT-TYPE AUTOMATION**	
Automated Flow lines - Methods of Work part Transport - Transfer Mechanism - Buffer Storage - Control Functions and Automation for Machining Operations - Design and Fabrication Considerations - Analysis of Automated Flow Lines: General Terminology and Analysis - Analysis of Transfer Lines Without Storage - Partial Automation - Computer Simulation of Automated Flow Lines.		12
UNIT III	**MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES**	
The material handling function - Types of Material Handling Equipment - Analysis for Material Handling Systems - Design of the System - Conveyor Systems - Automated Guided Vehicle Systems - Automated Storage Systems: Storage System Performance - Automated Storage/Retrieval Systems - Work-in-process Storage - Interfacing Handling and Storage with Manufacturing - Product identification system: Barcode, RFID.		12
UNIT IV	**CONTROL TECHNOLOGIES IN AUTOMATION**	
Industrial Control Systems - Process Industries Verses Discrete Manufacturing Industries - Continuous Verses Discrete Control - Computer Process Control and its Forms - Computer Based Industrial Control: Introduction & Automatic Process Control - Building Blocks of Automation System: LAN - Analog & Digital I/O Modules - SCADA System & RTU.		7

UNIT V	AUTOMATED ASSEMBLY AND TESTING	
Design for Automated Assembly - Types of Automated Assembly Systems - Part Feeding Devices - Analysis of Multi-station Assembly Machines - Analysis of a Single Station Assembly Machine. Inspection and testing - Statistical Quality Control - Automated Inspection Principles and Methods - Sensor Technologies for Automated Inspection - Coordinate Measuring Machines - Other Contact Inspection Methods - Machine Vision - Other optical Inspection Methods.		7
TOTAL PERIODS		**45**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Mini project that shall be an extension of any practical lab exercise to real-world application.

Text and Reference Books:

1. Krishna Kant, Computer Based Industrial Control, Second Edition, PHI Learning Pvt Ltd., 2010.
2. Tiess Chiu Chang & Richard A. Wysk, An Introduction to Automated Process Planning Systems Prentice-Hall, 2008.
3. Viswanandham N & Narahari Y, Performance Modeling of Automated Manufacturing Systems, First Edition, PHI Learning Pvt Ltd., 2009.

Web-based/Online Resources:

- https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf

1030236231	HVAC (R&AC)	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

To impart knowledge about HVAC system, handling the components and testing the performance is very much needed. This content would be useful to select the various types of components to be used in HVAC systems with different capacities. The knowledge about VFD compressor and capacity calculation of cooling coil is very essential in the present scenario.

Course Objectives:

The objective of this course is to enable the students to

- Find the CSR terminals and test the pumping capacity of sealed compressor
- Determine the heat transfer of air cooled condenser.
- Determine the capacity of cooling tower.
- Determine the capacity of sealed system by capillary tube and thermostatic expansion device.
- Determine the heat transfer of evaporator.
- Set and Adjust the low pressure cut out in VCR system.
- Draw the wiring diagram of RSIR and CSIR starting circuit.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Check the CSR terminals and test the pumping capacity of sealed compressor.
CO2	:	Determine the heat transfer of air cooled condenser for window and split air conditioner.
CO3	:	Determine the capacity of cooling tower and capacity of sealed system by expansion devices.
CO4	:	Determine the heat transfer of evaporator for window and split air conditioner.
CO5	:	Set and Adjust the low pressure cut out in VCR system and draw the wiring diagram of RSIR and CSIR starting circuit.

Pre-requisites: Basics of Science and Engineering.

1030236231	HVAC (R&AC)	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	2	1	3	1	1	2
CO2	3	2	2	2	1	1	2
CO3	1	2	1	3	1	1	2
CO4	3	2	2	3	1	1	2
CO5	3	2	2	3	1	1	2

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations, and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a rea environment as far as possible).

1030236231	HVAC (R&AC)	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test	Written Test	Practical Test	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Exercises	All Units	All Units
Duration	2 Periods	2 Periods	3 Periods	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 10 Marks. Best of one will be considered for the internal assessment of 10 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.
- **CA3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 15 Marks for the internal assessment.

Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Diagram, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION

Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Diagram & Procedure	20
C	Execution	15
D	Output/Result	15
E	Practical Documents (All Exercises)	30
F	Viva Voce	10
TOTAL		100

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236231	HVAC (R&AC)	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion :		
UNIT I	**COMPRESSOR**	Period
Compressor – Introduction - functions of a compressor – Classification - open type reciprocating compressor – Compression ratio, Clearance volume, Volumetric Efficiency-Definition only. Construction & working of single acting and single stage reciprocating compressor. Hermetically sealed compressors – construction and working - Differences between open type and hermetically sealed type compressor - variable frequency driven motor.		6
UNIT II	**CONDENSER**	Period
Condenser - Introduction – Functions ––Classification of condensers – Air cooled condenser, Water cooled condenser - Working of air cooled condensers - Types of air-cooled condenser – Natural convection air cooled condenser - forced convection air cooled condenser – Base mounted air-cooled condenser and Remote air-cooled.		6
UNIT III	**EXPANSION DEVICE AND COOLING TOWER**	Period
Expansion devices- Introduction – Functions – Types of expansion devices – Capillary tube, Automatic expansion valve, Thermostatic expansion valve – Construction and working only. Cooling tower - Functions of a cooling tower –. Types of cooling towers – Natural draft cooling towers – Construction and working of Atmospheric natural draft (spray type) cooling tower - Mechanical draft cooling tower – Construction and working of forced draft cooling tower - Definition of cooling tower range, approach and efficiency.		6
UNIT IV	**EVAPORATOR**	Period
Evaporator - Introduction – Functions - Types of evaporators – Bare tube coil evaporators- Finned evaporators - Plate evaporators - Shell and tube evaporators - Shell and coil evaporators - Natural convection evaporators - forced convection evaporators – Construction and working only.		6

1030236231	HVAC (R&AC)	L	T	P	C
PRACTICUM		2	0	2	3

UNIT V	**HVAC CONTROLS AND WIRING CIRCUIT**	Period
Motor Operating Components: Selector switch – OLP – Relay – Capacitor – Starting, Running. System Controls: LP, HP cutout –– Humidity control – Thermostat switch – Solenoid valve – CSIR and RSIR wiring circuit.		6
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Determination of CSR terminal of a refrigeration compressor.	3
2.	Testing the pumping capacity of sealed compressor.	3
3.	Determination of heat transfer of air cooled condenser for window air conditioner.	3
4.	Determination of heat transfer of air cooled condenser for split air conditioner.	3
5.	Determination of range, approach and efficiency of cooling tower.	3
6.	Determination of COP for sealed system by using capillary and thermostatic expansion device.	3
7.	Determination of heat transfer of evaporator for window air conditioner.	3
8.	Determination of heat transfer of evaporator for split air conditioner.	3
9.	Setting and Adjusting of low pressure cut out in VCR system.	3
10.	Wiring, Starting and Running of air conditioner with RSIR starting circuit and CSIR circuit.	3
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Prepare/Download a specification of the following: Various tools, Equipments and controls used in HVAC systems.
- Presentation/Seminars by students on any recent technological developments based on the course.

1030236231	HVAC (R&AC)	L	T	P	C
PRACTICUM		2	0	2	3

Text and Reference Books:

1. Arora and Domkundwar, A Course in Refrigeration and Air-conditioning, Dhanpat Rai & Sons Publication, 2018.
2. R.S Khurmi and J.K. Gupta, Textbook of Refrigeration and Air-conditioning, Fifth Edition, S. Chand & Co., 2020.
3. C.P. Arora, Refrigeration and Air-conditioning, Third Edition, Mc Graw Hill, 2017.

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	VCR experimental setup with LP Cutout, Capillary tube and TEV	1 No
2.	Sealed compressor, Multimeter and Pressure gauge	1 No
3.	Window air conditioner	6 Nos
4.	Split air conditioner	6 Nos
5.	Cooling tower	As Required

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1030236232	PCB DESIGN AND ASSEMBLY	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

Printed Circuit Boards (PCBs) are the core component in almost all the electronic gadgets used either for domestic or industrial purposes. PCBs hold almost all electronic components necessary for a device to function. Apart from electrically connecting, it also gives mechanical support to the electrical components. Using PCBs, a highly complicated circuit can be designed in a very small package which helps in reducing the size of electronic devices. PCB design can be done either manually or using software. Electronic design automation tools are software tools used for designing the schematic and layout of PCB.

Course Objectives:

The objective of this course is to enable the students to

- Learn about different types of printed circuit boards and Electronic Design Automation tool.
- Familiarize with drawing schematic for a given circuit.
- Familiarize with PCB layout design and generating gerber file.
- Study the PCB assembling process.
- Study manual fabrication of a given circuit

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Identify different types of Printed Circuit Boards (PCB) and Explain the differences between.

CO2 : Select the right components for a given analog circuit, draw the schematic and generate net list.

CO3 : Draw the PCB layout for an analog circuit and verify using design rule check. Generate gerber file, BOM.

CO4 : List out the steps involved in PCB assembly process.

CO5 : Fabricate a simple analog circuit manually.

Pre-requisites: Knowledge of working of electronic components and devices.

1030236232	PCB DESIGN AND ASSEMBLY	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	3	1	1	1
CO2	3	3	3	3	1	1	1
CO3	3	1	1	3	1	1	1
CO4	3	2	2	3	1	1	1
CO5	3	2	2	1	1	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.

- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.

- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.

- Application-Based Learning: Employ a theory-demonstrate-practice- activity strategy throughout the course to ensure outcome-driven learning and employability.

- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real- world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030236232	PCB DESIGN AND ASSEMBLY	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Practical Test	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Exercises	All Units	All Units
Duration	2 Periods	2 Periods	3 Periods	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	6^{th} Week	12^{th} Week	15^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 10 Marks. Best of one will be considered for the internal assessment of 10 Marks.
  The question setting details are as follows.
    - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
    - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
    - Maximum two sub-divisions shall be permitted in each question.
- **CA3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 15 Marks for the internal assessment.

Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION

Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Circuit Diagram in Software	20
C	Import & Preparation	10
D	Execution and Output/Result	20
E	Practical Documents (All Exercises)	30
F	Viva Voce	10
TOTAL		100

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

<u>Instructions to the Question Setters:</u>

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236232	PCB DESIGN AND ASSEMBLY	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion :		
UNIT I	**INTRODUCTION TO PCB DESIGN**	Period
Basics of electronic components and circuits - Introduction to PCB design -Types - Single layer - Double layer – Multi layer – Applications - Overview of PCB design process - Electronic Components and Footprints - Understanding component data sheets - Introduction to PCB design software (e.g KiCAD or any open source EDA Software).		6
UNIT II	**INTRODUCTION TO SCHEMATIC DESIGN**	Period
Introduction to schematic design- Drawing circuit schematics using EDA (Electronic Design Automation) tools - Net-list generation and Connectivity verification -Understanding PCB layer stack up - Board materials - Materials used for multilayer PCBs - PCB thickness - Units - Aspect ratio - Importance of grounding in PCBs - Impedance matching - Reflection- Ground Bounce - SSN.		6
UNIT III	**PCB DESIGN**	Period
PCB layout and routing using software tools – Vias - Solder Mask - Silk Screen Jumper - Design rule check - Troubleshooting and debugging common issues - Creation of accurate and comprehensive design documentation - Gerber file - Bill of Materials.		6
UNIT IV	**PCB ASSEMBLY**	Period
Flowchart for PCB assembly process - Steps involved in fabrication of single sided PCB, double sided PCB & multilayer PCB - Testing of PCB - Importance of RoHS(Restriction of use of Hazardous Substances) - Waste management of hazardous materials in PCB - Environment Management Standards (EMS) - RF PCB.		6
UNIT V	**MANUAL PCB FABRICATION**	Period
Schematic Diagram - PCB Layout - Transfer to copper clad board – Etching – Drilling - Component placement – Testing – Finishing.		6

1030236232	**PCB DESIGN AND ASSEMBLY**	L	T	P	C
PRACTICUM		2	0	2	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Familiarization of any Electronic design automation (EDA) software and Solder an analog circuit (Half wave rectifier) in a PCB with plated hole.	3
2.	Create a schematic, generate net list and simulate an RC coupled amplifier.	3
3.	Create a schematic, generate net list and simulate a High pass filter.	3
4.	Place the components of RC coupled amplifier and route the connections between the components manually and verify using design rule check.	3
5.	Place the components of RC coupled amplifier and route the connections between the components using auto routing option.	3
6.	Design a PCB layout for Astable Multivibrator circuit and verify using design rule check.	3
7.	Design a PCB layout for regulated power supply, verify using design rule check and generate gerber file, BOM.	3
8.	Create symbols and foot print for 1n4007diode and IC741.	3
Required Practical Instructions for Cycle I & II Experiments		6
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Viva Voce will be conducted before conducting an experiment.

1030236232	PCB DESIGN AND ASSEMBLY	L	T	P	C
PRACTICUM		2	0	2	3

Text and Reference Books:

1. R S Khandpur, Printed Circuit Boards: Design – Fabrication Hardcover, McGraw Hill Education, 2017.
2. Clyde F. Coombs, Happy T. Holden, Printed Circuits Handbook, Seventh Edition, McGraw Hill, 2016.
3. Er. S.D Mehta, Electronic Product Design Volume-I Basics of PCB Design, S Chand & Company, 2011.

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	Desktop Computer	15 Nos
2.	Printer	1 No
3.	Soldering Iron & Multimeter	6 Nos
4.	PCB Drilling Machine	6 Nos
5.	Plain PCB & Ferric Chloride	As Required
6.	Open Source Software – EDA	As Required

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1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

This subject covers the basics design of electronic systems from the ground up will enable the students in electronic system design. It deals with the challenges any modern system designer faces: the design process and its fundamentals, such as designing power source, electronic system like amplifiers, function generators etc. Assembly of electronic automation deign and semiconductor packaging with PCB design signal integrity, power integrity and thermal analysis, power distribution and noise signalling convention requirements and environmental-friendly design principles.

Course Objectives:

The objective of this course is to enable the students to

- Understand the overview of electronic system design.
- Learn the design principle of power sources.
- Interpret design of amplifiers and function generator.
- Study about electronic automation design.
- Study semiconductor package and electronic board design.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Explain overview of electronic system design.
CO2	:	Design principle of power sources.
CO3	:	Design of amplifiers and function generator.
CO4	:	Describe the function of electronic automation design.
CO5	:	Analyse the semiconductor package and electronic board design.

Pre-requisites:

- Fundamental knowledge on electronic devices and circuits.

1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	3	2	1	1	1
CO2	3	3	3	2	1	1	1
CO3	3	3	3	2	1	1	1
CO4	3	3	3	2	1	1	1
CO5	3	3	3	2	1		1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Practical Test	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Exercises	All Units	All Units
Duration	2 Periods	2 Periods	3 Periods	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 10 Marks. Best of one will be considered for the internal assessment of 10 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.
- **CA3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 15 Marks for the internal assessment.

Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Diagram, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION

Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Diagram and/or Design	20
C	Connections	10
D	Execution and Output/Result	20
E	Practical Documents (All Exercises)	30
F	Viva Voce	10
TOTAL		100

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion :		
UNIT I	**OVERVIEW OF ELECTRONIC PRODUCT DESIGN**	Period
Definition – Purpose and Scope – System Architecture for Electronic Product Designs – Breakdown of an electronic system design – Requirements - Electromagnetic interference in electronic systems and its impact - Concept of grounding and its significance.		6
UNIT II	**DESIGN OF POWER SOURCES**	Period
Introduction to low power design techniques and methodologies - Various types of power supplies - Estimation of power supply requirements and power loss in electronic products - Selection of appropriate power supplies for the given primary power sources (230VAC/Battery) - Design of power scheduler.		6
UNIT III	**AMPLIFIERS AND FUNCTION GENERATORS**	Period
Amplifiers: Emitter follower - Two stage direct coupled amplifiers - Design of audio power amplifier with drivers - Design of simple PA system - Voltage to current converter- current to voltage converter. Function Generators : AM signal demodulation using envelope detector - Design of FM signal using VCO (using IC NE566) - FM signal demodulation using phase discriminator.		6
UNIT IV	**ELECTRONIC AUTOMATION DESIGN**	Period
Circuit for Relay and motor control applications – SCADA architecture and applications – DCS architecture and applications – Block Diagram of Analog Data Acquisition System – Introduction to Transducer and types - Design of Electronic voltmeter, ammeter – and Multimeter.		6

1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

UNIT V	**SEMICONDUCTOR PACKAGES AND ELECTRONIC BOARD DESIGN**	Period
Semiconductor Packages: Single chip packages or modules - SCM Common packages and advanced packages - Materials in packages - Current trends in Packaging - Multichip modules (MCM) – types. Electronic Board Design: Introduction to high speed PCB design - Signal Integrity - Power Integrity and Thermal Analysis - Power distribution and noise - Signalling convention – terminations.		6
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Design of Voltage to Current converter system.	30
2.	Design of DC Power Supply Unit for 230V/12V, 1 Amps.	
3.	Design of Amplifier Circuit.	
4.	Design of AM Modulator and De-modulator.	
5.	Design of Electronic Ammeter.	
6.	Design of Electronic Voltmeter.	
7.	Design of Instrumentation Amplifier.	
8.	Design PCB for simple street light control circuit using LDR.	
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.
- Viva Voce will be conducted before conducting an experiment.
- E – Resources and E-Learning for the virtual learning environment to prepare the students ready for each and every circumstance.

Text and Reference Books:

1. John F. Wakerly, Digital Design: Principles & Practices, Third Edition, Prentice Hall International, 1999.
2. Walter C. Bosshart, Printed Circuit Boards - Design & Technology, First Edition; Tata McGraw Hill.
3. Kim R. Fowler, Electronic Instrument Design: Architecting for the Life Cycle, Latest Edition; Oxford University Press.
4. A.E Ward and J.A.S.Angus, Electronic Product Design, Stanley Thornes (Publishers) Ltd., 1999.

Web-based/Online Resources:

- https://resources.pcb.cadence.com/blog/2023-electronic-product-design-and-development.
- https://www.dsl-ltd.co.uk/what-is-electronic-product-design/
- https://predictabledesigns.com/how-to-develop-and-prototype-a-new-product/

1030236233	ELECTRONICS PRODUCT DESIGN	L	T	P	C
PRACTICUM		2	0	2	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	Desktop Computer	15 Nos
2.	Printer	1 No
3.	Soldering Iron, Multimeter & Other Tools	6 Nos
4.	PCB & PCB Drilling Machine	6 Nos
5.	Discrete Electronic Components	As Required

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1030236234	RENEWABLE ENERGY SYSTEMS	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

Renewable energy is energy that comes from a source that won't run out. They are natural and self-replenishing, and usually have a low- or zero-carbon footprint. Renewable resources are those resources that continue to exist despite being consumed or can replenish themselves over a period of time even as they are used. They include the sun, wind, water, geothermal, and biomass. Renewables are now cheaper in most countries, and generate three times more jobs than fossil fuels. Generation capacity has grown rapidly in recent years, driven by policy support and sharp cost reductions for solar photovoltaics and wind power in particular.

Course Objectives:

The objective of this course is to enable the students to

- Know the present status of Indian and global energy scenario.
- Learn the various solar energy technologies and its applications.
- Educate the various wind energy technologies.
- Explore the various bio-energy technologies.
- Study the ocean and geothermal technologies.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Illustrate the Indian and global energy scenario.

CO2 : Compare various solar energy technologies and identify its applications.

CO3 : Infer wind data and compare various wind energy systems.

CO4 : Examine various bio-energy technologies and identify their application.

CO5 : Interpret ocean and geothermal energy conversion technologies.

Pre-requisites:

- Basics of Science and Engineering.

1030236234	RENEWABLE ENERGY SYSTEMS	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	1	1	3	2	2
CO2	3	-	2	3	3	2	2
CO3	3	-	2	2	3	2	2
CO4	3	-	2	2	3	2	3
CO5	2	-	2	1	3	2	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030236234	RENEWABLE ENERGY SYSTEMS	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Practical Test	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Exercises	All Units	All Units
Duration	2 Periods	2 Periods	3 Periods	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 10 Marks. Best of one will be considered for the internal assessment of 10 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.
- **CA3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 15 Marks for the internal assessment.

Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Diagram, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION

Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Diagram and/or Procedure	20
C	Execution	10
D	Output/Result	20
E	Practical Documents (All Exercises)	30
F	Viva Voce	10
TOTAL		100

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

Instructions to the Question Setters:

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236234	RENEWABLE ENERGY SYSTEMS	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion :		
UNIT I	**ENERGY SCENARIO**	Period
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status - Potential of various renewable energy sources - Global energy status - Per capita energy consumption – Future energy plans.		6
UNIT II	**SOLAR ENERGY**	Period
Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum – Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems –Solar PV applications.		6
UNIT III	**WIND ENERGY**	Period
Wind data and energy estimation – Betz limit – Site selection for wind farms – characteristics – Wind resource assessment – Horizontal axis wind turbine – components – Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.		6
UNIT IV	**BIO-ENERGY**	Period
Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion – Biomass gasifier – Types of biomass gasifiers –Cogeneration – Carbonisation – Pyrolysis – Biogas plants – Digesters –Biodiesel production – Ethanol production – Applications.		6
UNIT V	**OCEAN AND GEOTHERMAL ENERGY**	Period
Small hydro – Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources – Types of geothermal power plants – Applications - Environmental impact.		6

1030236234	RENEWABLE ENERGY SYSTEMS	L	T	P	C
PRACTICUM		2	0	2	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Determining the characteristics of solar photovoltaic materials and estimation of MPP (I-V curve).	30
2.	Performance evaluation of solar cookers (box type and concentrating type).	
3.	Testing of biomass Gasifier in up draught / down draught mode. Study of biogas plant–fixed dome and floating drum model.	
4.	Proximate analysis of a given biofuel.	
5.	Estimation of calorific value of any solid fuels using bomb calorimeter.	
6.	Computation of calorific value of liquid fuels using Junkers gas calorimeter.	
7.	Synthesis of biodiesel –energy and mass balancing.	
8.	Performance evaluation of engine on biodiesel.	
	TOTAL PERIODS	**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course

Text and Reference Books:

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 2012.
2. M. Buchla David., Renewable Energy Systems, Pearson education publication, 2017.
3. S.P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill Publishing Company Ltd., 2009.
4. G.N. Tiwari, Solar Energy–Fundamentals Design, Modelling and applications, Alpha Science Intl Ltd, 2015.

Web-based/Online Resources:

- https://www.energy.gov/eere/renewable-energy
- https://www.edfenergy.com/energywise/renewable-energy-sources
- https://www.nrdc.org/stories/renewable-energy-clean-facts#sec-whatis

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	Solar PV Modules	5 Nos
2.	Solar Cooker	2 Nos
3.	Biomass Experiment setup	1 No
4.	Bomb Calorimeter	1 No
5.	Gas Calorimeter	1 No
6.	Demo Model of Wind Mill	1 No
7.	Solar Charge Controller and Inverter	1 No Each
8.	Rechargeable Battery	2 Nos
9.	Digital Multimeter	6 Nos
10.	Lamp Load	1 No

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1030236235	ENERGY CONSERVATION AND AUDITING	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

Energy resource scarcity becomes one of the biggest issues in the world and leading to rise in cost. Effective utilization of Electrical energy is one of the key issues to minimize the rising cost of energy and to minimize the global warming. This course will educate the non-electrical engineers on the aspect of energy conservation in electrical equipment and Electrical Installations. It will helpful to select an energy efficient electrical system for an establishment.

Course Objectives:

The objective of this course is to enable the students to

- Understand the basic principle of Energy Management, energy audit and benchmarking process.
- Understand the Selection of Energy Efficient gadgets for industrial applications and process involved in power factor improvement.
- Understand the energy efficiency in induction motors.
- Understand the energy efficiency in lighting systems and DG set system.
- Understand the prevailing energy efficient technologies in electrical systems.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1	:	Explain the basic principle of Energy Management and Conservation.
CO2	:	Select Energy Efficient gadgets for domestic, commercial and industrial Applications.
CO3	:	Estimate the energy performance of Electrical Equipment.
CO4	:	Get familiar about the energy conservation practice.
CO5	:	Practice simple experiment using Soft Starter.

Pre-requisites:

- Basics of Electrical and Electronics Engineering,

1030236235	ENERGY CONSERVATION AND AUDITING	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	1	1	1	1
CO2	3	1	2	1	1	1	1
CO3	3	2	3	1	1	1	1
CO4	3	2	3	1	1	1	1
CO5	3	1	2	1	1	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Understand the audience and their current level of knowledge regarding energy conservation and audit.
- Start with foundational concepts such as the principles of energy conservation, types of energy sources, and the environmental impact of energy consumption.
- Teach participants how to conduct a thorough energy audit, including data collection, analysis techniques, and evaluation of energy-saving opportunities.
- Introduce participants to various energy-efficient technologies and strategies, such as LED lighting, HVAC optimization, and renewable energy systems.
- Incorporate hands-on activities such as energy audits, simulations, and experiments to reinforce learning.
- Encourage group discussions to promote peer learning, idea sharing, and problem-solving.

1030236235	ENERGY CONSERVATION AND AUDITING	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Practical Test	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Exercises	All Units	All Units
Duration	2 Periods	2 Periods	3 Periods	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	6^{th} Week	12^{th} Week	15^{th} Week	16^{th} Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 10 Marks. Best of one will be considered for the internal assessment of 10 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.
- **CA3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 15 Marks for the internal assessment.

Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Diagram, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION

Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Diagram	20
C	Connections	10
D	Execution and Output/Result	20
E	Practical Documents (All Exercises)	30
F	Viva Voce	10
TOTAL		100

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

<u>Instructions to the Question Setters:</u>

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236235	ENERGY CONSERVATION AND AUDITING	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion :		
UNIT I	**ENERGY MANAGEMENT AND AUDIT**	Period
Need of Energy Audit - Types of energy audit, Energy audit approach - understanding energy costs - Bench marking, Energy performance - Matching energy use to requirement - Maximizing system efficiencies - optimizing the input energy requirements - Fuel and energy substitution - Energy Audit instruments.		6
UNIT II	**ELECTRICAL SYSTEM**	Period
Electricity billing - Electrical load management and maximum demand control - Power factor improvement and its benefits - Selection and location of capacitors - Performance assessment of PF capacitors - Distribution and transformer losses.		6
UNIT III	**ELECTRIC MOTORS**	Period
Losses in induction motors - Motor efficiency - Factors affecting motor performance - Rewinding and motor replacement issues - Energy saving opportunities with energy efficient motors.		6
UNIT IV	**LIGHTING**	Period
Lighting – Light Source, Choice of lighting, Luminance requirements and energy conservation avenues. DG Set System – Factors affecting selection, Energy performance assessment of diesel conservation avenues.		6
UNIT V	**ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS**	Period
Maximum demand controllers - Automatic power factor controllers - Energy efficient motors - Soft starters with energy saver - Variable speed drives - Energy efficient transformers - Electronic Ballast - Occupancy sensors - Energy efficient lighting controls.		6

1030236235	ENERGY CONSERVATION AND AUDITING	L	T	P	C
PRACTICUM		2	0	2	3

Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Compare and verify the energy consumption for LED lamp and Incandescent lamp with same Lumens.	30
2.	Control the water pump motor by using sensors to avoid overflow of overhead tank.	
3.	Construct Automatic street light control using LDR and Arduino.	
4.	Compare and verify the energy consumption of Copper Choke and Electronic Choke for same ratting tube light.	
5.	Construct lighting circuit for a room with Occupancy sensor.	
6.	Measure the Current, Power and Energy consumption of Modern BLDC Ceiling Fan.	
7.	Connect Soft starter with suitable rating Induction Motor and Observe its operation during starting and running. Also measure the current and power consumption.	
8.	Collect Electricity bills of typical residential or College service connections for the period of 1 year and prepare the bar chart of energy consumption and energy cost. Discuss the result.	
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Practical case studies of energy conservation and Illumination system.
- Power requirement for different domestic appliances.

Text and Reference Books:

1. Book I - General aspect of energy management and energy audit, Second Edition 2005, By Bureau of Energy Efficiency, Ministry of Power, India.
2. Book III - Energy efficiency in electrical utilities, Second Edition 2005, By Bureau of Energy Efficiency, Ministry of Power, India.
3. Mehmet Kanoglu, Yunus A Cengel, Energy Efficiency and Management for Engineers, First Edition, McGraw-Hill Education, 2020.
4. MoncefKrati, Energy Audit of Building Systems: An Engineering Approach, Third Edition, CRC Press, Dec.2020
5. Sonal Desai, Handbook of Energy Audit, McGraw Hill Education (India) Private Limited, 2017.

Web-based/Online Resources:

- Energy Conservation Act-2001 https://youtu.be/QRT5mYp7B_g?si=yfV2VCccL8Ku5O-N
- Basics of Energy Conservation https://youtu.be/RPjcgmR4USg?si=In5wolfr4eclRaDY

1030236235	ENERGY CONSERVATION AND AUDITING	L	T	P	C
PRACTICUM		2	0	2	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	LED Lamp, Incandescent Lamp, Digital Power Monitor	Each 2 Nos
2.	Pump Motor with Sensor arrangement	1 No
3.	Arduino Shield, LDR, Relay and Lamp	Each 1 No
4.	Copper Choke and Electronic Choke	Each 3 Nos
5.	Tube Light with accessories	3 Nos
6.	BLDC Ceiling Fan	2 Nos
7.	Soft Starter with Induction Motor	1 No
8.	Digital Power Monitor	2 Nos

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1030236236	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

In electric drive control systems, the main goal is to maintain the driving motor speed to meet the mechanism's requirements. In some practical industrial applications the mechanically-coupled load to the motor shaft has a varying mass during the system operation.

Course Objectives:

The objective of this course is to enable the students to

- Understand motor load dynamics.
- Study and analyze the operation of the converter fed and chopper fed dc drives.
- Study and understand braking methods of D.C. and Induction motor drive.
- Study synchronous and BLDC motor drive.
- Understand the modes of operation of drive in various applications.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Explain motor load dynamics and multi quadrant operation of drives.

CO2 : Analyze operation of converter fed and chopper fed DC drives.

CO3 : Apply different braking methods of D.C. and induction motor drive.

CO4 : Elaborate vector control for induction motor and BLDC drives.

CO5 : Elaborate synchronous motor, reluctance motor drive & select suitable drives in various industrial applications.

Pre-requisites:

- Basics of Electrical and Electronics Engineering
- Knowledge of basic types of Drives and Control Method.

1030236236	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	1	2	2	-	1	1
CO2	2	1	2	2	-	1	1
CO3	2	1	2	2	-	1	1
CO4	2	1	2	2	-	1	1
CO5	2	1	2	2	-	1	1

Legend: 3-High Correlation, 2-Medium Correlation, 1-Low Correlation

Instructional Strategy:

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and engineering applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice-activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1030236236	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test	Written Test	Practical Test	Model Theory Examination	Written Examination
Portion	2 Units	Another 2 Units	All Exercises	All Units	All Units
Duration	2 Periods	2 Periods	3 Periods	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	-

Note:

- **CA1 and CA2:** Written Assessment test should be conducted for 50 Marks from two units. The marks scored will be converted to 10 Marks. Best of one will be considered for the internal assessment of 10 Marks.
  The question setting details are as follows.
  - EIGHT questions to be asked (4 questions from each unit) and students should answer any FIVE questions. Each question carries 10 Marks.
  - **Total Marks: 5 Questions X 10 Marks = 50 Marks**.
  - Maximum two sub-divisions shall be permitted in each question.
- **CA3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The marks awarded will be converted to 15 Marks for the internal assessment.

Practical document (Hand written document / Notebook consists of Aim, Apparatus Required, Circuit, Procedure and Result) should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated for 10 Marks for each exercise / experiment. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

SCHEME OF EVALUATION - Practical Test

Part	Description	Marks
A	Aim & Apparatus Required	10
B	Circuit Diagram	20
C	Connection	10
D	Execution and Output/Result	20
E	Practical Documents (All Exercises)	30
F	Viva Voce	10
TOTAL		100

- **CA4:** Model theory examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment. The question setting details are as follows.

Model Theory Examination and End Semester Examination

Theory Exam

<u>Instructions to the Question Setters:</u>

- Exam Duration : 3 Hours and Maximum Marks : 100
- TWENTY questions to be asked (4 questions from each unit) and students should answer TEN questions by choosing two questions from each unit. Each question carries 10 marks.
- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

1030236236	**ELECTRICAL DRIVES AND CONTROLS**	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion :		
UNIT I	**ELECTRICAL DRIVES**	Period
Definition - Components of electric drive system - Types of electrical drives (DC and AC) - selection of drive parameters - List of Industrial Applications. Motor - Load dynamics - speed-torque conventions and multi-quadrant operation - equivalent values of drive parameters - load torque components - nature and classification of load - constant power operation of a drive - steady-state stability.		6
UNIT II	**DC MOTOR DRIVES**	Period
Single-phase and three-phase fully controlled converter drives - Performance of converter fed separately excited DC Motor for speed control operations - 12 pulse converter drives. Chopper controlled drives for separately excited and series DC Motor operations - Closed-loop speed control of DC motor below and above base speed for starting, speed control and braking.		6
UNIT III	**INDUCTION MOTOR DRIVES**	Period
Regenerative braking - Dynamic braking – Plugging - Numerical based on braking and speed control - Voltage Source Inverter (VSI) control - Steady State Analysis - Current Source Inverter (CSI) control - Open and closed loop - Regenerative braking - Multi quadrant operation of Induction motor drives - Principle of vector control - Block diagram of Vector control of induction motor - Failure modes of Drives.		6
UNIT IV	**BLDC DRIVE**	Period
Construction (Block diagram) and working for motoring and regenerative braking - Speed and torque Characteristics - Closed loop control of BLDC drive (PI controller) - Vector control of BLDC drive - Applications in EV (descriptive treatment).		6

1030236236	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
PRACTICUM		2	0	2	3

UNIT V	SYNCHRONOUS MOTOR DRIVES & DRIVES APPLICATIONS	Period
PMSM Drive: Construction (Block diagram) and working for motoring and regenerative braking - Speed and torque Characteristics - Closed loop control of PMSM drive (PI controller) - Vector control of PMSM drive. Synchronous Reluctance Motor - Introduction, working of SRM, application in EV (descriptive treatment).		6
Practical Exercises:		
Ex.No	Name of the Experiment	Period
1.	Electrical braking of D.C. Shunt motor (Rheostatic, Plugging).	30
2.	Closed Loop Speed Control of AC Motor	
3.	Closed Loop Speed Control of BLDC Motor	
4.	Closed loop control of PMSM drive.	
5.	Single phase fully converter fed separately excited D.C. Motor	
6.	Simulation of Induction Motor Vector Control	
7.	VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control characteristics	
8.	Simulation of closed loop control of BLDC / PMSM drive.	
TOTAL PERIODS		**60**

Note: *Common Test and Revision periods can be used for conducting Continuous Assessment.*

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.
- Periodic class quizzes conducted on a weekly/fortnightly based on the course.

1030236236	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
PRACTICUM		2	0	2	3

Text and Reference Books:

1. Gopal K. Dubey, Fundamentals of Electric Drives, 2nd Edition, Narosa Publishing House, 2010.
2. Nisit K. De, Prasanta K. Sen, Electric Drives, Ninth Printing, Prentice Hall of India Pvt Ltd., 2006.
3. M.D. Singh and K.B. Khanchandani, Power Electronics, Second Edition, Tata Mc-Graw Hill, 2017.
4. Austin Huges, Bill Drury, Electric Motors and Drives: Fundamentals, Types and Applications, Fifth Edition, Newnes, 2019.

Web-based/Online Resources:

- https://instrumentationtools.com/electrical-drive-types-advantages-disadvantages/
- https://www.electrical4u.com/control-of-electrical-drives/

1030236236	ELECTRICAL DRIVES AND CONTROLS	L	T	P	C
PRACTICUM		2	0	2	3

Equipment / Facilities required to conduct the Practical Course. (Batch Strength: 30 Students)

S.No	Name of the Equipment's	Quantity Required
1.	D.C. Shunt Motor Braking Kit	1 No
2.	Closed Loop Speed Control of AC Motor System	1 No
3.	Closed Loop Speed Control of BLDC Motor System	1 No
4.	Closed loop control of PMSM drive.	1 No
5.	Single phase fully converter fed separately excited D.C. Motor	1 No
6.	Simulation Software	1 No
7.	VSI fed 3 phase Induction motor Kit	1 No

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1030236351	INTERNSHIP	Period	C
PROJECT		540	12

Introduction:

Internships in educational institutions are designed to provide students with practical experience in their field of study and to bridge the gap between academic knowledge and professional practice.

Course Objectives:

After completing Internship, Interns will be able to,

- Apply the theoretical knowledge and skill during performance of the tasks assigned in internship.
- Demonstrate soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship.
- Document the Use case on the assigned Task.
- Enable interns to apply theoretical knowledge gained in the classroom to real-world practical applications.
- Provide hands-on experience in the industrial practices.
- Develop essential skills such as communication, organization, teamwork, and problem-solving.
- Enhance specific skills related to the intern's area of focus.
- Offer a realistic understanding of the daily operations and responsibilities.
- Provide opportunities to work under the guidance of experienced supervisors and administrators.
- Allow interns to explore different career paths.
- Help interns make informed decisions about their future career goals based on first hand experience.
- Facilitate the establishment of professional relationships with supervisor, administrators, and other professionals in the field.
- Provide access to a network of contacts that can be beneficial for future job opportunities and professional growth.
- Foster personal growth by challenging interns to step out of their comfort zones and take on new responsibilities.

1030236351	INTERNSHIP	Period	C
PROJECT		540	12

- Build confidence and self-efficacy through successful completion of internship tasks and projects.
- Give insight into the policies, regulations, and administrative practices.
- Allow interns to observe and understand the implementation of standards and policies in practice.
- Provide opportunities for constructive feedback from supervisors and mentors, aiding in the intern's professional development.
- Enable self-assessment and reflection on strengths, areas for improvement, and career aspirations.
- Encourage sensitivity to the needs and backgrounds of different groups, promoting inclusive and equitable industrial practices.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Demonstrate improved skills.

CO2 : Apply theoretical knowledge and principles in real-world practices.

CO3 : Apply theoretical knowledge and principles in real-world practices.

CO4 : Develop and utilize assessment tools to evaluate the learning and practices.

CO5 : Engage in reflective practice to continually improve their learning and professional growth.

Facilitating the Interns by an Internship Provider:

- Orient intern in the new workplace. Give interns an overview of the organization, Explain the intern's duties and introduce him or her to co-workers.
- Develop an internship job description with clear deliverables and timeline.
- Allow the interns in meetings and provide information, resources, and opportunities for professional development.
- The interns have never done this kind of work before, they want to know that their work is measuring up to organizational expectations, hence provide professional guidance and mentoring to the intern.

1030236351	INTERNSHIP	Period	C
PROJECT		540	12

- Daily progress report of Intern is to be evaluated by industry supervisor. Examine what the intern has produced and make suggestions. Weekly supervision meetings can help to monitor the intern's work.

Duties Responsibilities of the Faculty Mentor:

- To facilitate the placement of students for the internship
- To liaison between the college and the internship provider
- To assist the Industrial Training Supervisor during assessment

Instructions to the Interns:

- Students shall report to the internship provider on the 1st day as per the internship schedule.
- Intern is expected to learn about the organization, its structure, product range, market performance, working philosophy etc.
- The interns shall work on live projects assigned by the internship provider.
- The Intern shall record all the activities in the daily log book and get the signature of the concerned training supervisor.
- Intern shall have 100% attendance during internship programme. In case of unavoidable circumstances students may avail leave with prior permission from the concerned training supervisor of the respective internship provider. However, the maximum leave permitted during internship shall be as per company norms where they are working and intern shall report the leave sanctioned details to their college faculty mentor.
- The interns shall abide all the Rules and Regulations of internship provider.
- Intern shall follow all the safety Regulations of internship provider.
- On completion of the internship, the intern shall report to the college and submit the internship certificate mentioning duration of internship, evaluation of interns by internship provider, Student's Diary and Comprehensive Training Report.

1030236351	INTERNSHIP	Period	C
PROJECT		540	12

Attendance Certification:

Every month students have to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution supervisor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Training Reports:

The students have to prepare two types of reports: Weekly report in the form of diary to be submitted to the concerned staff in-charge of the institution. This will be reviewed while awarding Internal Assessment mark.

Industrial Training Diary:

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

Comprehensive Training Report:

In addition to the diary, students are required to submit a comprehensive report on training with details of the organisation where the training was undergone after attestation by the supervisors. The comprehensive report should incorporate study of plant/product/process/construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training. Any data, drawings etc. should be incorporated with the consent of the Organisation.

1030236351	INTERNSHIP	Period	C
PROJECT		540	12

Scheme of Evaluation

Internal Assessment

Students should be assessed for 50 Marks by industry supervisor and polytechnic faculty mentor during course period. The total marks (50 + 50) scored shall be converted to 40 marks for the Internal Assessment.

Sl. No.	Description	Marks
A	Punctuality and regularity. (Attendance)	10
B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Ability to solve practical problems. Sense of responsibility	10
D	Self expression / communication skills. Interpersonal skills / Human Relation.	10
E	Report and Presentation.	10
Total		50

1030236351	INTERNSHIP	Period	C
PROJECT		540	12

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of internship period. The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report on Internship, Relevant Internship Certificate from the concerned department.	30
C	Presentation by the student at the end of the Internship.	30
D	Viva Voce	20
Total		100

***

1030236353	FELLOWSHIP	Period	C
PROJECT		540	12

Introduction:

The Fellowship in the Diploma in Engineering program is designed to provide aspiring engineers with a comprehensive educational experience that combines theoretical knowledge with practical skills. This fellowship aims to cultivate a new generation of proficient and innovative engineers who are equipped to meet the challenges of a rapidly evolving technological landscape.

Participants in this fellowship will benefit from a robust curriculum that covers core engineering principles, advanced technical training, and hands-on projects. The program emphasizes interdisciplinary learning, encouraging fellows to explore various branches of engineering, from mechanical and civil to electrical, electronics & communication and computer engineering. This approach ensures that graduates possess a versatile skill set, ready to adapt to diverse career opportunities in the engineering sector.

In addition to academics, the fellowship offers numerous opportunities for professional development. Fellows will engage with industry experts through seminars, workshops, and internships, gaining valuable insights into real-world applications of their studies. Collaborative projects and research initiatives foster a culture of innovation, critical thinking, and problem-solving, essential attributes for any successful engineer.

By offering this fellowship, participants become part of a vibrant community of learners and professionals dedicated to advancing the field of engineering. The program is committed to supporting the growth and development of each fellow, providing them with the tools and resources needed to excel both academically and professionally.

The Fellowship in the Diploma in Engineering is more than just an educational endeavor; it is a transformative journey that equips aspiring engineers with the knowledge, skills, and experiences necessary to make significant contributions to society and the engineering profession.

1030236353	FELLOWSHIP	Period	C
PROJECT		540	12

Course Objectives:

After completing students will be able to,

- Provide fellows with a solid foundation in core engineering principles and advanced technical knowledge across various engineering disciplines.
- Equip fellows with hands-on experience through laboratory work, projects, and internships, ensuring they can apply theoretical knowledge to real-world scenarios.
- Promote interdisciplinary understanding by encouraging exploration and integration of different engineering fields, fostering versatility and adaptability in fellows.
- Encourage innovation and creativity through research projects and collaborative initiatives, enabling fellows to develop new solutions to engineering challenges.
- Facilitate professional growth through workshops, seminars, and interactions with industry experts, preparing fellows for successful careers in engineering.
- Develop critical thinking and problem-solving skills, essential for tackling complex engineering problems and making informed decisions.
- Strengthen connections between academia and industry by providing opportunities for internships, industry visits, and guest lectures from professionals.
- Foster leadership qualities and teamwork skills through group projects and collaborative activities, preparing fellows for leadership roles in their future careers.
- Instill a sense of ethical responsibility and awareness of the social impact of engineering practices, encouraging fellows to contribute positively to society.
- Promote a culture of lifelong learning, encouraging fellows to continually update their knowledge and skills in response to technological advancements and industry trends.
- Prepare fellows to work in a global engineering environment by exposing them to international best practices, standards, and cross-cultural experiences.

1030236353	FELLOWSHIP	Period	C
PROJECT		540	12

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Demonstrate a strong understanding of core engineering principles and possess the technical skills necessary to design, analyze, and implement engineering solutions across various disciplines.

CO2 : Apply theoretical knowledge to practical scenarios, effectively solving engineering problems through hands-on projects, laboratory work, and internships.

CO3 : Exhibit the ability to conduct research, develop innovative solutions, and contribute to advancements in engineering through critical thinking and creative approaches to complex challenges.

CO4 : Understand and adhere to professional and ethical standards in engineering practice, demonstrating responsibility, integrity, and a commitment to sustainable and socially responsible engineering.

CO5 : Enhance strong communication skills, both written and verbal, and be capable of working effectively in teams, demonstrating leadership and collaborative abilities in diverse and multidisciplinary environments.

Important points to consider to select the fellowship project.

Selecting the right fellowship project is crucial for maximizing the educational and professional benefits of a Diploma in Engineering program.

- **Relevance to Future Plans**: Choose a project that aligns with your long-term career aspirations and interests. This alignment will ensure that the skills and knowledge you gain will be directly applicable to your desired career path.
- **Industry Relevance**: Consider the current and future relevance of the project within the industry. Opt for projects that address contemporary challenges or emerging trends in engineering.
- **Access to Facilities**: Ensure that the necessary facilities, equipment, and materials are available to successfully complete the project. Lack of resources can hinder the progress and quality of your work.

- **Mentorship and Guidance**: Select a project that offers strong mentorship and support from experienced faculty members or industry professionals. Effective guidance is crucial for navigating complex problems and achieving project objectives.
- **Project Scope**: Assess the scope of the project to ensure it is neither too broad nor too narrow. A well-defined project scope helps in setting clear objectives and achievable milestones.
- **Feasibility**: Evaluate the feasibility of completing the project within the given timeframe and with the available resources. Consider potential challenges and ensure you have a realistic plan to address them.
- **Technical Skills**: Choose a project that allows you to develop and enhance important technical skills relevant to your field of study. Practical experience in using specific tools, technologies, or methodologies can be highly beneficial.
- **Soft Skills**: Consider projects that also offer opportunities to develop soft skills such as teamwork, communication, problem-solving, and project management.
- **Innovative Thinking**: Select a project that encourages creativity and innovative problem-solving. Projects that push the boundaries of traditional engineering approaches can be particularly rewarding.
- **Societal Impact**: Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social good can be highly fulfilling and make a meaningful difference.

Guidelines to select Fellowship:

- Ensure the program is accredited by a recognized accrediting body and has a strong reputation for quality education in engineering.
- Ensure it covers core engineering principles that align with your interests and career goals.
- Investigate the qualifications and experience of the faculty mentor. Look for programs with faculty who have strong academic backgrounds, industry experience, and active involvement in research.
- Check if the program provides adequate hands-on training opportunities, such as laboratory work, workshops, and access to modern engineering facilities and equipment.

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PROJECT		540	12

- Assess the program’s connections with industry. Strong partnerships with companies can lead to valuable internship opportunities, industry projects, and exposure to real-world engineering challenges.
- Explore the availability of research opportunities. Participation in research projects can enhance your learning experience and open doors to innovative career paths.
- Look for programs that offer professional development resources, such as workshops, seminars, and networking events with industry professionals and alumni.
- Ensure the program provides robust support services, including academic advising, career counseling, mentorship programs, and assistance with job placement after graduation.
- Consider the cost of the program and available financial aid options, such as scholarships, grants, and fellowships. Evaluate the return on investment in terms of career prospects and potential earnings.
- Research the success of the program’s alumni. High employment rates and successful careers of past graduates can indicate the program’s effectiveness in preparing students for the engineering field.

Duties Responsibilities of the Faculty Mentor:

Each student should have a faculty mentor for the Institute.

- Get the approval from the Chairman Board of Examinations with the recommendations of the HOD/Principal for the topics.
- Provide comprehensive academic advising to help fellows select appropriate specializations, and research projects that align with their interests and career goals.
- Guide fellows through their research projects, offering expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field.
- Assist fellows in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.
- Offer career advice and support, helping fellows explore potential career paths, prepare for job searches, and connect with industry professionals and opportunities.
- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.

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- Facilitate connections between fellows and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure.
- Ensure fellows have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of fellows, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging fellows to practice integrity and responsibility in their work.
- Assist with administrative tasks related to the fellowship program, such as preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development of fellows.
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

Instructions to the Fellowship Scholar:

- Regularly meet with your faculty mentor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your mentor.
- Develop strong organizational skills. Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.
- Take advantage of opportunities to participate in research projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.
- Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and seminars that enhance these competencies.
- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.

- Seek internships, co-op programs, or part-time jobs related to your field of study. Real-world experience is invaluable for understanding industry practices and enhancing your employability.
- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

Documents to be submitted by the student to offer fellowship.

- **Completed Application Form**: This is typically the standard form provided by the institution or fellowship program that includes personal information, educational background, and other relevant details.
- **Detailed CV/Resume**: A comprehensive document outlining your educational background, knowledge experience, interest in research experience, publications, presentations, awards, and other relevant achievements if any.
- **Personal Statement**: A document explaining your motivation for applying to the fellowship, your career goals, how the fellowship aligns with those goals, and what you intend to achieve through the program.
- **Recommendation Letters**: Letters from faculty mentor, employer, or professionals who can attest to your academic abilities, professional skills, and suitability for the fellowship.
- **Proposal/Description**: A detailed proposal or description of the fellowship project or study you plan to undertake during the fellowship. This should include objectives, methodology, expected outcomes, and significance of the project.
- **Enrollment Verification**: Documentation verifying your current acceptance status in the academic institution or industry where the fellowship will be conducted.
- **Funding Information**: Details about any other sources of funding or financial aid you are receiving, if applicable. Some fellowships may also require a budget proposal for the intended use of the fellowship funds.

- **Samples of Work**: Copies of the relevant work that demonstrates your capabilities and accomplishments in your field.
- **Endorsement Letter**: A letter from your current academic institution endorsing your application for the fellowship, if required.
- **Ethical Approval Documents**: If your research involves human subjects or animals, you may need to submit proof of ethical approval from the relevant ethics committee.
- **Additional Documents**: Any other documents requested by the fellowship program required by the institution.

Attendance Certification:

Every month students have to get their attendance certified by the supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the faculty mentor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Rubrics for Fellowship.

Sl. No.	Topics	Description
1	Alignment with Objectives	Assess how well the project aligns with the stated objectives and requirements. Determine if the student has addressed the key aspects outlined in the project guidelines.
2	Depth of Research:	Evaluate the depth and thoroughness of the literature review. Assess the student's ability to identify and address gaps in existing research.
3	Clarity of Objectives:	Check if the student has clearly defined and articulated the objectives of the project. Ensure that the objectives are specific, measurable, achievable, relevant, and time-bound (SMART).

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4	Methodology and Data Collection:	Evaluate the appropriateness and justification of the research methodology. Assess the methods used for data collection and their relevance to the research questions.
5	Analysis and Interpretation:	Examine the quality of data analysis techniques used. Assess the student's ability to interpret results and draw meaningful conclusions.
6	Project Management:	Evaluate the project management aspects, including adherence to timelines and milestones. Assess the student's ability to plan and execute the project effectively.
7	Documentation and Reporting:	Check the quality of documentation, including code, experimental details, and any other relevant materials. Evaluate the clarity, structure, and coherence of the final report.
8	Originality and Creativity:	Assess the level of originality and creativity demonstrated in the project. Determine if the student has brought a unique perspective or solution to the research problem.
9	Critical Thinking:	Evaluate the student's critical thinking skills in analyzing information and forming conclusions. Assess the ability to evaluate alternative solutions and make informed decisions.
10	Problem-Solving Skills:	Evaluate the student's ability to identify and solve problems encountered during the project. Assess adaptability and resilience in the face of challenges.

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INTERNAL MARKS - 40 Marks

As per the rubrics each topic should be considered for the Review 1 and Review 2. Equal weightage should be given for all the topics. It should be assessed by a faculty mentor and the industrial professional or research guide.

Review 1 shall be conducted after 8th week and Review 2 shall be conducted after 14th week in the semester. Average marks scored in the reviews shall be considered for the internal assessment of 40 Marks.

Scheme of Evaluation

PART	DESCRIPTION	MARKS
A	Assessment as per the rubrics.	30
B	Attendance	10
Total		**40**

END SEMESTER EXAMINATION - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of fellowship. The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report of the Fellowship Work.	30
C	Presentation by the student.	30
D	Viva Voce	20
Total		100

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Introduction:

- Every student must do one major project in the Final year of their program. Students can do their major project in Industry or R & D Lab or In-house or a combination of any two for the partial fulfillment for the award of Diploma in Engineering.

- For the project works, the Department will constitute a three-member faculty committee to monitor the progress of the project and conduct reviews regularly.

- If the projects are done in-house, the students must obtain the bonafide certificate for project work from the Project supervisor and Head of the Department, at the end of the semester. Students who have not obtained the bonafide certificate are not permitted to appear for the Project Viva Voce examination.

- For the projects carried out in Industry, the students must submit a separate certificate from Industry apart from the regular bonafide certificate mentioned above. For Industry related projects there must be one internal faculty advisor / Supervisor from Industry (External), this is in addition to the regular faculty supervision.

- The final examination for project work will be evaluated based on the final report submitted by the project group of not exceeding four students, and the viva voce by an external examiner.

Course Objectives:

Academic project work plays a crucial role in the education of Diploma in Engineering students, as it helps them apply theoretical knowledge to practical situations and prepares them for real-world engineering challenges.

- **Integration of Knowledge:** Consolidate and integrate theoretical knowledge acquired in coursework to solve practical engineering problems.
- **Skill Development:** Enhance technical skills related to the specific field of engineering through hands-on experience and application.
- **Problem-Solving Abilities:** Develop critical thinking and problem-solving abilities by

addressing complex engineering issues within a defined scope.

- **Project Management:** Gain experience in project planning, execution, and management, including setting objectives, timelines, and resource allocation.
- **Teamwork and Collaboration:** Foster teamwork and collaboration by working in multidisciplinary teams to achieve project goals and objectives.
- **Research Skills:** Acquire research skills by conducting literature reviews, gathering relevant data, and applying research methodologies to investigate engineering problems.
- **Innovation and Creativity:** Encourage innovation and creativity in proposing and developing engineering solutions that may be novel or improve upon existing methods.
- **Communication Skills:** Improve communication skills, both oral and written, by presenting project findings, writing technical reports, and effectively conveying ideas to stakeholders.
- **Ethical Considerations:** Consider ethical implications related to engineering practices, including safety, environmental impact, and societal concerns.
- **Professional Development:** Prepare for future professional roles by demonstrating professionalism, initiative, and responsibility throughout the project lifecycle.

Course Outcomes:

On successful completion of this course, the student will be able to

CO1 : Demonstrate the ability to apply theoretical concepts and principles learned in coursework to solve practical engineering problems encountered during the project.

CO2 : Develop and enhance technical skills specific to the field of engineering relevant to the project, such as design, analysis, simulation, construction, testing, and implementation.

CO3 : Apply critical thinking and problem-solving skills to identify, analyze, and propose solutions to engineering challenges encountered throughout the project lifecycle.

CO4 : Acquire project management skills by effectively planning, organizing, and executing project tasks within defined timelines and resource constraints.

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CO5 : Improve communication skills through the preparation and delivery of project reports, presentations, and documentation that effectively convey technical information to stakeholders.

Important points to consider to select the In-house project.

- Selecting a project work in Diploma Engineering is a significant decision that can greatly influence your learning experience and future career prospects.
- Choose a project that aligns with your career aspirations and interests within the field of engineering. Consider how the project can contribute to your professional development and future opportunities.
- Ensure the project aligns with your coursework and specialization within the Diploma program. It should complement and build upon the knowledge and skills you have acquired in your studies.
- Evaluate the scope of the project to ensure it is manageable within the given timeframe, resources, and constraints. Avoid projects that are overly ambitious or impractical to complete effectively.
- Assess the availability of resources needed to conduct the project, such as equipment, materials, laboratory facilities, and access to relevant software or tools. Lack of resources can hinder project progress.
- Select a project that genuinely interests and motivates you. A project that captures your curiosity and passion will keep you engaged and committed throughout the project duration.
- Consider the availability and expertise of faculty advisors or industry mentors who can provide guidance and support throughout the project. Effective mentorship is crucial for success.
- Clearly define the learning objectives and expected outcomes of the project. Ensure that the project will help you achieve specific learning goals related to technical skills, problem-solving, and professional development.
- Look for opportunities to propose innovative solutions or explore new methodologies within your project. Projects that encourage creativity can set you apart and enhance your learning experience.

- Consider ethical implications related to the project, such as safety protocols, environmental impact, and compliance with ethical guidelines in research and engineering practices.
- Evaluate whether the project offers opportunities for collaboration with peers, experts from other disciplines, or industry partners. Interdisciplinary projects can broaden your perspective and enhance your teamwork skills.
- Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social good can be highly fulfilling and make a meaningful difference.

By carefully considering these points, Diploma Engineering students can make informed decisions when selecting project work that not only enhances their academic learning but also prepares them for successful careers in engineering.

Duties Responsibilities of the internal faculty advisor.

Each group should have an internal faculty advisor assigned by the HOD/Principal.

- The in-house project should be approved by the project monitoring committee constituted by the Chairman Board of Examinations.
- The in-house project should be selected in the fifth semester itself. Each in-house project shall have a maximum of four students in the project group.
- Provide comprehensive academic advising to help in the selection of appropriate in-house project that align with their interests and career goals.
- Offer expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field.
- Assist in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.
- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.
- Facilitate connections between students and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure.

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- Ensure students have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of the in-house project, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging students to practice integrity and responsibility in their work.
- Assist in preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development.
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

Instructions to the students.

- Regularly meet with your internal faculty advisor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your faculty advisor.
- Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.
- Take advantage of opportunities to participate in in-house projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.
- Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and seminars that enhance these competencies.
- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.
- Seek internships, co-op programs, or part-time jobs related to your field of study. Real-world experience is invaluable for understanding industry practices and enhancing your employability.

- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

Documents to be submitted by the student for an in-house project.

- Submit a printed report of your in-house project work along with the fabrication model / analysis report for the End Semester Examination.

Rubrics for In-House Project Work

Sl. No.	Topics	Description
1.	Objectives	Clearly defined and specific objectives outlined. Objectives align with the project's scope and purpose.
2.	Literature Review	Thorough review of relevant literature. Identification of gaps and justification for the project's contribution.
3.	Research Design and Methodology	Clear explanation of the research design. Appropriateness and justification of chosen research methods.
4.	Project Management	Adherence to project timeline and milestones. Effective organization and planning evident in the project execution.
5.	Documentation	Comprehensive documentation of project details. Clarity and completeness in recording methods, results, and challenges.

6.	Presentation Skills	Clear and articulate communication of project findings. Effective use of visuals, if applicable.
7.	Analysis and Interpretation	In-depth analysis of data. Clear interpretation of results in the context of research questions.
8.	Problem-Solving	Demonstrated ability to identify and address challenges encountered during the project. Innovative solutions considered where applicable.
9.	Professionalism and Compliance	Adherence to ethical standards in research. Compliance with project guidelines and requirements.
10.	Quality of Work	Overall quality and contribution of the project to the field. Demonstrated effort to produce high-quality work.

SCHEME OF EVALUATION

The mark allocation for Internal and End Semester Viva Voce are as below.

Internal Mark Split (40 Marks)*		
Review 1 (10 Marks)	Review 2 (15 Marks)	Review 3 (15 marks)
Committee: 5 Marks. Supervisor: 5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks

Note: * The rubrics should be followed for the evaluation of the internal marks during reviews.

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END SEMESTER EXAMINATION - Project Exam

The performance of each student in the project group would be evaluated in a viva voce examination conducted by a committee consisting of an external examiner and the Department project supervisor and an internal examiner.

End Semester (100)#			
Record (20 Marks)	Presentation (20 Marks)	Viva Voce (20 Marks)	Model / Analysis Report (40 Marks)
External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 20 Internal: 10 Supervisor: 10

 # The marks scored will be converted to 60 Marks.

Students who are unable to complete the project work at the end of the semester can apply for an extension to the Head of the Department, with the recommendation from the project guide for a period of a maximum of two months. For those students who extend the project work for two months, Viva Voce will be carried out and results will be declared separately. If the project report is not submitted even beyond the extended time, then students are not eligible to appear for Project Viva Voce Examination.

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