Regulation 2023
Program Structure

1047 - Diploma in Mechatronics (Regular)
1049 - Diploma in Electronics (Robotics) (Regular)

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 through the program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. 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 engineering fundamentals and an engineering specialization to solve the engineering problems.

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

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

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

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

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

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

CREDIT DISTRIBUTION

Semester	No of Courses	Periods	Credits
Semester I	8	640	20
Semester II	9	640	20
Semester III	8	640	20
Semester IV	7	670	21
Semester V	8	635#	21
Semester VI	3	630	18
		Total	**120**

Industrial Training during Summer vacation for Two Weeks has to be completed to earn the required two credits.

GOVERNMENT OF TAMIL NADU
DEPARTMENT OF TECHNICAL EDUCATION
DIPLOMA IN ENGINEERING & TECHNOLOGY - REGULATION 2023
1047 DIPLOMA IN MECHATRONICS ENGINEERING (FT)

Semester III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1047233110	Linear and Digital Integrated Circuits	3-0-0	45	3	Theory
2	Program Core	Theory	1047233210	Measuring Instruments and Sensors	4-0-0	60	4	Theory
3	Program Core	Practical	1047233320	CAD for Automation	0-0-4	60	2	Practical
4	Engineering Science	Practical	1047233420	C and Python Programming	0-0-4	60	2	Practical
5	Program Core	Practicum	1047233540	Manufacturing Technology	1-0-4	75	3	Practical
6	Program Core	Practicum	1047233640	Introduction to Mechatronics Systems	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1047233760	Advanced Skills Certification - III	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	1047233880	Growth Lab	-	30	0	-
9	Audit Course	Integrated Learning Experience	1047233881	Induction Program - II	-	16	0	-
10	Audit Course	Integrated Learning Experience	1047233882	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11	Audit Course	Integrated Learning Experience	1047233883	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	1047233884	Student-Led Initiative	-	22	0	-
13	Audit Course	Integrated Learning Experience	1047233885	Emerging Technology Seminars	-	8	0	-
14	Audit Course	Integrated Learning Experience	1047233886	Health & Wellness	0-0-2	30	1	-
					Test & Revisions	60		NA
					Library	15		
					Total	**640**	**20**	

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1047 DIPLOMA IN MECHATRONICS ENGINEERING (FT)

Semester IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1047234110	Microcontroller and Interfacing	4-0-0	60	4	Theory
2	Program Core	Practicum	1047234230	Low Cost Automation	3-0-2	75	4	Theory
3	Program Core	Practical	1047234320	Embedded Programming	0-0-4	60	2	Practical
4	Program Core	Practicum	1047234440	Mechanics of Materials.	1-0-4	75	3	Practical
5	Program Core	Practicum	1047234540	Industrial Drives and Control	1-0-4	75	3	Practical
6	Program Core	Practicum	1047234640	Fundamentals of Internet of Things	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1047234760	Advanced Skills Certification - IV	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	1047234882	I&E/ Club Activity/ Community Initiatives	-	30	0	-
9	Audit Course	Integrated Learning Experience	1047234883	Shop floor Immersion	-	8	0	-
10	Audit Course	Integrated Learning Experience	1047234884	Student-Led Initiative	-	24	0	-
11	Audit Course	Integrated Learning Experience	1047234885	Emerging Technology Seminars	-	8	0	-
12	Audit Course	Integrated Learning Experience	1047234886	Health & Wellness	-	30	0	-
13	Audit Course	Integrated Learning Experience	1047234887	Special Interest Groups (Placement Training)	-	30	0	-
					Test & Revisions	30		
					Library	30		
					Total	**670**	**21**	

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Semester V								
#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1047235110	Robotics	3-0-0	45	3	Theory
2	Program Core	Practicum	1047235230	Control System for Mechatronics	3-0-2	75	4	Theory
3	Program Core	Practical	1047235320	Robotics Practical	0-0-4	60	2	Practical
4	Program Core	Practicum	1047235440	CIM& CNC Programming	1-0-4	75	3	Practical
5	Program Core	Practicum		Elective 1	1-0-4	75	3	Practical
6	Humanities & Social Science	Practicum	1047235654	Innovation and Start-ups	1-0-2	45	2	Project
7	Project/Internship	Project/Internship	1047235773	Industrial Training* [Summer Vacation - 90 Hours] / Mini Project (SW)	0-0-4	-	2	Project
8	Open Elective	Advanced Skill Certification	1047235860	Advanced Skills Certification - V	1-0-2	60	2	NA
9	Audit Course	Integrated Learning Experience	1047235981	Induction program - III	-	40	0	-
10	Audit Course	Integrated Learning Experience	1047235984	Student-Led Initiative	-	30	0	-
11	Audit Course	Integrated Learning Experience	1047235986	Health & Wellness	-	30	0	-
12	Audit Course	Integrated Learning Experience	1047235987	Special Interest Groups (Placement Training)	-	40	0	-
					Test & Revisions	45		
					Library	15		
					Total	**635**	**21**	

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1047 DIPLOMA IN MECHATRONICS ENGINEERING (FT)

Semester VI

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Open Elective	Theory		Electives - II (Pathway)	3-0-0	45	3	Theory
2	Open Elective	Practicum		Elective - III (Specialization)	3-0-0	45	3	Theory
3	Industrial Training / Project	Project/Internship		In-house Project / Internship / Fellowship ** Industrial Training (SW)	-	540	12	Project
					Total	**630**	**18**	
3	Industrial Training / Project	Project/Internship	1047236351	Internship	-	540	12	Project
3	Industrial Training / Project	Project/Internship	1047236353	Fellowship	-	540	12	Project
3	Industrial Training / Project	Project/Internship	1047236374	In-house Project	-	540	12	Project
3	Industrial Training / Project	Project/Internship	2047234274 2047237274	Industrial Training (SW)	-	540	12	Project

Note: ** Every student should select any one from the In-House Project or Internship or Fellowship. The guidelines given have to be followed.
For the Sandwich programme, Industrial Training in the fourth and seventh semester will be given. The guidelines given have to be followed.

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Elective - I								
#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Practicum	1047235531	PLC and HMI	1-0-4	75	3	Practical
2	Program Elective	Practicum	1040235544	PCB Design and Family&	1-0-4	75	3	Practical
3	Elective	Practicum	1020236246	Electric Vehicle Technology$	1-0-4	75	3	Practical
4	Elective	Practicum	1020236247	Reverse Engineering$	1-0-4	75	3	Practical
5	Elective	Practicum	1020236248	Green Energy & Engineering$	1-0-4	75	3	Practical

Courses from other Programmes with the same credit can be considered after proper approval from the Chairman Board of Examinations.
$ Courses common with mechanical; & Common with Electronics and Communication

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Elective – II (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 | Technologists	Theory	1030236115	Industrial Management And Safety @	3-0-0	45	3	Theory
6	Elective | Open elective	Theory		Online Elective Courses *	3-0-0	45	3	Theory

*** Online courses with the same credit available in AICTE, SWAYAM, NPTEL and reputed Institutions with the proper evaluation system and certification can be considered after proper approval from the Chairman Board of Examinations.**
@ Common with Electrical

GOVERNMENT OF TAMIL NADU
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1047 DIPLOMA IN MECHATRONICS ENGINEERING (FT)

Elective - IV (Specialization)

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Elective	Theory	1030236116	Battery Management System@	3-0-0	45	3	Theory
2	Elective	Theory	1020236115	Industry 4.0$	3-0-0	45	3	Theory
3	Elective	Theory	1020236116	Additive Manufacturing$	3-0-0	45	3	Theory
4	Elective	Theory	1042236115	Bio Medical Instrumentation#	3-0-0	45	3	Theory

@ - Common with EEE, $ - Common with Mechanical, # - Common with Instrumentation

2047 - Diploma in Mechatronics (Sandwich)

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 through the program.

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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 engineering fundamentals and an engineering specialization to solve the engineering problems.

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

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

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

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

PO7: Life-long learning: Ability to analyse individual needs and engage in updating in the context of technological changes.

CREDIT DISTRIBUTION

Semester	No of Courses	Periods	Credits
Semester I	8	640	20
Semester II	9	640	20
Semester III	8	640	20
Semester IV	2	615	15
Semester V	8	655	24
Semester VI	7	620	20
Semester VII	2	600	14
		Total	**133**

Industrial Training during Summer vacation for Two Weeks has to be completed to earn the required two credits.

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DIPLOMA IN ENGINEERING & TECHNOLOGY - REGULATION 2023
2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Semester III								
#	**Course Category**	**Course Type**	**Code**	**Course Title**	**L-T-P**	**Period**	**Credit**	**End Exam**
1	Program Core	Theory	1047233110	Linear and Digital Integrated Circuits	3-0-0	45	3	Theory
2	Program Core	Theory	1047233210	Measuring Instruments and Sensors	4-0-0	60	4	Theory
3	Program Core	Practical	1047233320	CAD for Automation	0-0-4	60	2	Practical
4	Engineering Science	Practical	1047233420	C and Python Programming	0-0-4	60	2	Practical
5	Program Core	Practicum	1047233540	Manufacturing Technology	1-0-4	75	3	Practical
6	Program Core	Practicum	1047233640	Introduction to Mechatronics Systems	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1047233760	Advanced Skills Certification - III	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	1047233880	Growth Lab	-	30	0	-
9	Audit Course	Integrated Learning Experience	1047233881	Induction Program - II	-	16	0	-
10	Audit Course	Integrated Learning Experience	1047233882	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11	Audit Course	Integrated Learning Experience	1047233883	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	1047233884	Student-Led Initiative	-	22	0	-
13	Audit Course	Integrated Learning Experience	1047233885	Emerging Technology Seminars	-	8	0	-
14	Audit Course	Integrated Learning Experience	1047233886	Health & Wellness	0-0-2	30	1	-
					Test & Revisions	60		NA
					Library	15		
					Total	**640**	**20**	

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2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Semester IV								
#	**Course Category**	**Course Type**	**Code**	**Course Title**	**L-T-P**	**Period**	**Credit**	**End Exam**
1	Program Core	Practicum	1047234640	Fundamentals of Internet of Things	1-0-4	75	3	Practical
2	Industrial Training/Project	Project/Internship	2047234274	Industrial Training (SW) – I	-	540	12	Project
					Total	**615**	**15**	

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2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Semester V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory – 5	1047234110	Microcontroller and Interfacing	4-0-0	60	4	Theory
2	Program Core	Practicum – 5	1047234230	Low Cost Automation	3-0-2	75	4	Theory
3	Program Core	Practical – 5	1047234320	Embedded Programming	0-0-4	60	2	Practical
4	Program Core	Practicum – 5	1047234440	Mechanics of Materials.	1-0-4	75	3	Practical
5	Program Core	Practicum – 5	1047235230	Control System for Mechatronics	3-0-2	75	4	Theory
6	Program Core	Practicum – 5		Elective 1	1-0-4	75	3	Practical
7	Humanities & Social Science	Practicum - 5	1047235654	Innovation and Start-ups	1-0-2	45	2	Project
8	Open Elective	Advanced Skill Certification	1047234760	Advanced Skills Certification - IV	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	1047234882	I&E/ Club Activity/ Community Initiatives	-	15	0	-
9	Audit Course	Integrated Learning Experience	1047234883	Shop floor Immersion	-	8	0	-
10	Audit Course	Integrated Learning Experience	1047234884	Student-Led Initiative	-	24	0	-
11	Audit Course	Integrated Learning Experience	1047234885	Emerging Technology Seminars	-	8	0	-
12	Audit Course	Integrated Learning Experience	1047234886	Health & Wellness	-	15	0	-
13	Audit Course	Integrated Learning Experience	1047234887	Special Interest Groups (Placement Training)	-	15	0	-
					Test & Revisions	30		
					Library	15		
					Total	**655**	**24**	

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2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Semester VI								
#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Practicum	1047234540	Industrial Drives and Control	1-0-4	75	3	Practical
2	Program Core	Theory	1047235110	Robotics	4-0-0	60	4	Theory
3	Program Core	Practical	1047235320	Robotics Practical	0-0-4	60	2	Practical
4	Program Core	Practicum	1047235440	CIM& CNC Programming	1-0-4	75	3	Practical
5	Open Elective	Theory		Electives - II (Pathway)	3-0-0	45	3	Theory
6	Open Elective	Practicum		Elective - III (Specialization)	3-0-0	45	3	Theory
7	Open Elective	Advanced Skill Certification	1047235860	Advanced Skills Certification - V	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	1047235981	Induction program - III	-	40	0	-
9	Audit Course	Integrated Learning Experience	1047235984	Student-Led Initiative	-	30	0	-
10	Audit Course	Integrated Learning Experience	1047235986	Health & Wellness	-	30	0	-
11	Audit Course	Integrated Learning Experience	1047235987	Special Interest Groups (Placement Training)	-	40	0	-
					Test & Revisions	45		
					Library	15		
					Total	**620**	**20**	

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2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Semester VII

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Project/Internship	Project/Internship	2047237173	Mini Project (SW)	0-0-4	60	2	Project
2	Industrial Training / Project	Project/Internship	2047237274	Industrial Training (SW) – II	-	540	12	Project
					Total	600	14	

Note: Mini Project can be done as per the guidelines of in-house project.

Elective - I

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Practicum	1047235531	PLC and HMI	1-0-4	75	3	Practical
2	Program Elective	Practicum	1040235544	PCB Design and Family&	1-0-4	75	3	Practical
3	Elective	Practicum	1020236246	Electric Vehicle Technology$	1-0-4	75	3	Practical
4	Elective	Practicum	1020236247	Reverse Engineering$	1-0-4	75	3	Practical
5	Elective	Practicum	1020236248	Green Energy & Engineering$	1-0-4	75	3	Practical

Courses from other Programmes with the same credit can be considered after proper approval from the Chairman Board of Examinations.
$ Courses common with mechanical; & Common with Electronics and Communication

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2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Elective – II (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 | Technologists	Theory	1030236115	Industrial Management And Safety @	3-0-0	45	3	Theory
6	Elective | Open elective	Theory		Online Elective Courses *	3-0-0	45	3	Theory

* Online courses with the same credit available in AICTE, SWAYAM, NPTEL and reputed Institutions with the proper evaluation system and certification can be considered after proper approval from the Chairman Board of Examinations.
@ Common with Electrical

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2047 DIPLOMA IN MECHATRONICS ENGINEERING (SANDWICH)

Elective - III (Specialization)

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Elective	Theory	1030236116	Battery Management System@	3-0-0	45	3	Theory
2	Elective	Theory	1020236115	Industry 4.0$	3-0-0	45	3	Theory
3	Elective	Theory	1020236116	Additive Manufacturing$	3-0-0	45	3	Theory
4	Elective	Theory	1042236115	Bio Medical Instrumentation#	3-0-0	45	3	Theory

@ - Common with EEE, $ - Common with Mechanical, # - Common with Instrumentation

Regulation 2023

Diploma in Mechatronics

III SEMESTER SYLLABUS

1047233110	LINEAR AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
THEORY		3	0	0	3

Introduction:

This course on Linear and Digital Integrated Circuits has been designed primarily as a core course for diploma level students. This course will impart in depth knowledge of Number Systems, Logics of Combinational &Sequential circuits and Analog circuits. It is 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

- Understand the basics of digital logic, including Boolean algebra and logic gates.
- Demonstrate a comprehensive understanding of the functions of basic arithmetic circuits and essential combinational circuits in digital systems.
- Understand and apply Flipflops, Counters and Registers.
- Understand the principle and operation of ADC, DAC, 555 timer and Voltage regulator.

Course Outcomes:

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

CO1 : Analyse the characteristics and applications of operational amplifiers.

CO2 : Simplify the complex discrete function using logic gates.

CO3 : Construct basic arithmetic circuits and essential combinational circuits using logic gates.

CO4 : Describe and differentiate SR, D, JK, and T flip-flops, Counter and Registers using symbolic representations and truth tables

CO5 : Explain the principles and operation of ADCs (Analog-to-Digital Converters), DACs (Digital-to-Analog Converters), 555 timers, and voltage regulators.

1047233110	LINEAR AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
THEORY		3	0	0	3

Pre-requisites:

Basics of Science, Basic Electrical Engineering and Basic algebra and calculus skills for solving equations.

CO/PO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	-	-	2
CO2	3	2	2	-	-	-	2
CO3	3	2	1	1	-	-	2
CO4	3	2	1	1	-	-	2
CO5	3	2	1	2	-	1	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 analyse potential sources of error in case of discrepancies.
- 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 the circuits.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 15 marks for the internal assessment.

Question Pattern:

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Theory Portion:		
UNIT I	OP-AMP IC 741	Period
Operational Amplifiers: Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency Response. CMRR. Slew Rate and concept of Virtual Ground. **Applications of Op-Amps**: Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Comparator and Zero-crossing detector, Active low pass Filter ,I to V Converter ,V to I Converter		9

1047233110	LINEAR AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
THEORY		3	0	0	3

UNIT II	LOGIC GATES	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 - Realization of basic logic gates using NAND and NOR universal gates - Tristate buffer circuit. Simplification of Boolean expression using Karnaugh map (up to 4 variable)-Constructing logic circuits for the Boolean expressions.		9
UNIT III	COMBINATIONAL CIRCUITS	Period
Arithmetic circuits : Half adder - Full adder - Half Subtractor - Full Subtractor Multiplexer-Demultiplexer-Encoder-Decoder-Parity Generator and Checker.		9
UNIT IV	SEQUENITAL CIRCUITS	Period
SR, D, JK, T Flip Flops: Symbolic Representations, Truth tables and List of Applications. Counters – List the classification - Difference between synchronous and asynchronous counters – Asynchronous counter (using negative edge triggered JK flip flop only) - UP Counter and Down Counter. Shift register – Classification of shift register-4 bit shift register – Serial in Serial out – Parallel in serial out.		9
UNIT V	A/D, D/A ,SPECIAL FUNCTION ICs AND IC VOLTAGE REGULATORS	Period

A/D CONVERTER - Analog to digital conversion using Ramp method – Successive approximation method – Dual slope method – Specifications of A/D converter **D/A CONVERTER** - Basic concepts – Weighted Resistor D/A converter – R-2R Ladder D/A converter – Specifications of DAC IC SPECIAL FUNCTION ICs – IC 555 Timer – Pin diagram - Functional Block diagram of IC 555 in Astable and Monostable Multivibrator mode - Schmitt trigger using IC 555 **IC VOLTAGE REGULATORS** - Positive IC Voltage Regulators: 78XX - Negative IC Voltage Regulators: 79XX and General purpose IC Voltage Regulators using LM 723.	9
TOTAL PERIODS	**45**

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. Roychoudhury, D. & Jain, Shail B., *Linear Integrated Circuits*, 2nd Edition, New Age International Publishers, 2004.
2. Suseela, B. & Ganesh Babu, T.R., *Linear Integrated Circuits*, Scitech Publication, 2018.
3. Kumar, A. Anand, *Fundamentals of Digital Circuits*, 4th Edition, PHI Learning, 2016.
4. Gothmann, William H., *Digital Electronics – An Introduction to Theory and Practice*, PHI, 1998.

Web-based/Online Resources:

- NPTEL/SWAYAM 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:Digitalcircuitshttps://nptel.ac.in/courses/108/105/108105132
- https://nptel.ac.in/courses/117/106/117106086
- https://nptel.ac.in/courses/117/106/

1047233210	MEASURING INSTRUMENTS AND SENSORS	L	T	P	C
THEORY		3	0	0	3

INTRODUCTION:

Mechatronics Engineers plays a major role in process industries. It needs a brief idea about the basic concepts of instrumentation, various sensors, transducers and their characteristics which can be helpful to them to study the core subjects during their academics. This subject covers the basic needs of instrumentation and it makes the student's to understand the importance of instrumentation in industries.

OBJECTIVES:

On completion of the following syllabus contents, the students must be able to

- Knowing the concept of analog and digital instruments and its characteristics
- Realize the importance of three basic forces required in meters.
- Understand the Various types of transducers
- Understand the various types of strain, temperature measurement.
- Understand the various types of force measurement.
- Understand the various pressure measuring devices.
- Understand the Various Flow measuring devices.
- Understand the Various types of Sensors
- Explain ultrasonic, hall effect, pyroelectric sensors for various measurements.
- Study advanced sensors for various measurements.
- Understand recent trends in sensors technologies

1047233210	MEASURING INSTRUMENTS AND SENSORS	L	T	P	C
THEORY		3	0	0	3

Course Outcomes: After successful completion of this course, the students should be able to

CO1: Acquire knowledge on the fundamentals of measuring instruments, analog and digital instruments.

CO2: Examine the instruments for pressure and force measurement.

CO3: Analyze the instruments for temperature and force measurements.

CO4: Evaluate performance characteristics of different types of sensors and transducers.

CO5: Identify different type of sensors used in real life applications and paraphrase their importance.

Pre-requisites: Knowledge of basic Physics, Electrical and non Electrical Parameters

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

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.
- Focus on understanding the practical applications and operational principles rather than memorizing.

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

1047233210	MEASURING INSTRUMENTS AND SENSORS	L	T	P	C
THEORY		3	0	0	3

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.

1047233210	MEASURING INSTRUMENTS AND SENSORS	L	T	P	C
THEORY		3	0	0	3

- **Total Marks: 10 Questions X 10 Marks = 100 Marks**.
- Maximum two sub-divisions shall be permitted in each question.

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Theory Portion		
UNIT I	ANALOG AND DIGITAL INSTRUMENTS	Period
Chapter1.1 General-definition of measurement - Functions of measurement system - indicating, Recording and Controlling functions- Applications of measurement systems Chapter 1.2 Characteristics of Instruments–True value, Accuracy, Precision, Sensitivity, Reproducibility, Drift, Static Error and Correction, Resolution. Chapter 1.3 Classification of Instruments–Primary and Secondary Instruments - indicating, Recording and integrating instruments-calibration-Necessity of calibration Chapter 1.4 Operating forces – Deflecting, Controlling and Damping force. Chapter 1.5 Instruments - Permanent Magnet Moving Coil instrument, Attraction type Moving Iron Instrument, Chapter 1.6 Digital Instruments : Digital frequency counter, Digital Tachometer		9
UNIT II	PRESSURE AND FORCE MEASUREMENT	Period
Chapter 2.1 PressureMeasurement: Unit of pressure –Mechanical PressureMeasurement: U tubemanometer-single column Manometers Elastic type pressure gauges: Bourdon type – Metallic Diaphragm - ring		9

balance- Pirani Vacuum Gauge Chapter 2.2 Force Measurements:- Force–Work–Torque–scales & balances–equal arm beam balance–pendulum scale-proving Ring – Hydraulic load cell – Pneumatic load cell – Strain gauge load cell		
UNIT III	TEMPERATURE AND FLOW MEASUREMENTS:	Period
Chapter3.1 TemperatureMeasurement: Basic Behaviour–Physical Effects-Temperature Measurement: Mechanical Thermometers - Thermistors–Thermocouples – Radiation Pyrometers Chapter3.2 FlowMeasurements: Mechanical Flow Meters: Orifice Flow Meter-Venturi flowmeter-Turbine Meter- Rota Meter		9
UNIT IV	SENSORS AND TRANSDUCERS	Period
Chapter 4.1 General: Definition, difference between sensors and transducers, classification – Active and Passive sensors. Chapter 4.2 Light Sensor : LDR, IR, Photo voltic Cell, Photo Transistor, Photo Diode & Optocoupler Chapter 4.3 Position Sensor: Inductive Proximity sensor, Capacitive Proximity sensor and Optical Proximity sensor, LVDT,		9
UNIT V	APPLICATIONS OF SENSORS:	Period
Chapter 5.1 Motion sensors: PIR – Passive Infrared sensor for moment detection, MEMS for Vibration detection. Chapter 5.2 Ultrasonic sensors: Ultra sonic sensor for Level Measurement and Distance Measurement. Chapter 5.3 Halleffect Sensors: Halleffect sensors for Fluid level measurement. Chapter5.4 FiberopticSensors: Temperature sensors, Liquid level sensing, Microbend sensors, Advantages of fiber optic sensors		9

1047233210	MEASURING INSTRUMENTS AND SENSORS	L	T	P	C
THEORY		3	0	0	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 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/

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

Introduction:

This course enables students to become familiar with the usage of CAD software and can meet the needs of companies by leveraging skills and knowledge across CAD design in mechanical and electrical engineering. Students practice creating blocks of mechanical, electrical, or electronic components and dynamically inserting them in different layers of assembly/circuit layouts. Exercise also included to enhance design, innovate, open source the existing components from the design centre library, and deliver the design innovation at speed.

Course Objectives:

The student will learn to

- understand the various CAD tools modules and workspace.
- practice to use CAD tools in mechanical and electrical engineering design.
- draw the various joints, links, couplings and electrical components.
- understand the GD&T and finishing symbols used in engineering drawings.
- procedure to about the blocks and layers.
- find and apply engineering drafting standards.
- obtain the required components from the design centre library.
- edit and customize the imported components as per the design requirements.
- set print layouts and converting CAD files into required file format for exporting.

Course Outcomes:

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

CO1: Customize the CAD workspace and tools to improve the productivity in design.

CO2: Draw the mechanical components using CAD commands and modules.

CO3: Apply the block and layers in electrical symbols, layouts and electronic circuits.

CO4: Select the appropriate components available in the design center library

CO5: Convert the CAD file to various file format to export and print out.

Pre-requisites:

Knowledge of engineering drawing and mathematics

Mapping of COs with POs:

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

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

Instructional strategy:

Apart from laboratory skill practices, Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and demonstration to be used to attain the outcomes.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Micro-projects/ additional exercises may be given to individual/ group of students to encourage self-learning, creativity and innovation.
- Incorporating industry examples and field visit to manufacturing facilities fosters experiential learning.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Assessment methods include practical assessment exams.

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		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	Practical Test	Practical Examination
Portion	First Cycle 50% Exercises	Second Cycle Another 50% Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	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 given. The marks awarded will be converted to 10 marks for each assessment test. The best one will be considered for the Internal Assessment of 10 marks.
  Cycle 1 - Exercises 1, 2, 4, 5 and 7.
  Cycle 2 - Exercises 3, 6, 8, 9 and 10.

SCHEME OF EVALUATION

Part	Description	Marks
A	Drawing Component / Assembly / Layout / Circuit	**30**
B	Blocks, Layers, Annotations/ Symbols	**15**
C	Print out/ Save the file	**5**
	Total Marks	**50**

- **CA3**: Practical document of work done should be maintained for every exercise 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 and End Semester Examination with a bonafide certificate.

  The details of the documents to be prepared as per the instruction below.
  Each exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next exercise.
  This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The output of each exercise should be taken as print out and kept along with the practical documents by the student.
  The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

- **CA4:** All the exercises should be completed and kept for the practical test. After completion of all the exercises, Model examination should be conducted as per end semester exam question pattern. 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 given. The marks awarded should be converted to 20 marks for the internal assessment.

SCHEME OF EVALUATION FOR PRACTICAL EXAMINATION:

Description	Marks
Drawing Component / Assembly / Layout / Circuit	**55**
Blocks, Layers, Annotations/ Symbols	**25**
Print out	**10**
Viva voce	**10**
Total Marks	**100**

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

SYLLABUS CONTENT:

Introduction to AutoCAD: Name of the Topics: Introduction Sectional views, Limits, Fits, Tolerance, GD&T Surface Finish - Draw commands, Dimstyle, Osnap options, Drafting setting and Function keys - Edit and Modify commands, Pedit, Text edit - View groups, Inquiry, Block commands – Hatching – Layer: color and line, properties – Matchprop - File commands, model, layout setting, Plotting, External reference. Introduction to Indian Electricity Rules, List of electrical symbols. **PRACTICAL EXERCISES**		60
Ex. No.	Name of the Exercise	
1	Draw the orthographic top view any two robotic/ mechanical links.	
2	Draw the orthographic top view of any two robotic/ mechanical joints.	
3	Draw the orthographic top view of any two robotic/ mechanical gripper.	
4	Draw the orthographic view of any two threaded fasteners.	
5	Draw the 2D model of a mechanism for automation (cam and follower).	
6	Draw the assembly of induction motor end elevation top half in section	
7	Create the single line diagram of electrical symbols (switch, wire, contactor, motor, transformer) using layers and block.	
8	Create a single-line diagram of an electrical circuit using the available components in the library or outsourcing on the web.	
9	Prepare the layout/ plan of a robotic work cell using a block diagram.	
10	Prepare a single line diagram of PLC panel wiring consists of the main breaker switch, bus bar, circuit breakers, relays, contactors, PLC, fuses, SMPS, terminal boards, utility sockets, and earthing points.	
TOTAL HOURS		60

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

TEXT/REFERENCE BOOKS:

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

BOOK TITLE/AUTHORS/PUBLICATION
Autodesk AutoCAD 2023 and AutoCAD LT 2023, Jaiprakash Pandey Yasser Shoukry
AutoCAD 2023: A Power Guide for Beginners and Intermediate Users, Sandeep Dogra
AutoCAD Electrical 2024 Black Book, Gaurav Verma, Matt Weber
Engineering Drawing, D.N. Ghose, Dhanpat Rai & Sons, Delhi
Machine Drawing, P.S. Gill, Katsan Publishing House, Ludiana
AutoCAD Electrical 2023 for Engineers & Designers By Sham Tickoo

WEB-BASED/ONLINE RESOURCES:

https://www.autodesk.in/campaigns/autocad-tytorials
https://www.mycadsite.com/tutorials.html
https://www.youtube.com/watch?app=desktop&v=Rib-_ZK8KfE
https://www.youtube.com/watch?v=asPzWqRAgRg
https://www.youtube.com/watch?v=xoWmECynYA0
https://www.youtube.com/watch?v=cmR9cfWJRUU
https://www.youtube.com/watch?v=jzLQDEUwiG0 (3 phase induction motor)

LIST OF EQUIPMENTS:

No.	Name of the Equipment	No. of Quantity
1	Personal computer	30
2	Printer	1
3	Required Software: CAD Package AutoCAD (Mechanical and Electrical)	Sufficient to the strength
4	Internet	Sufficient to the strength

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

Exercise: 1. Orthographic top view of the robotic/ mechanical links.

Links: Links is used in a manufacturing automation cell to perform task of lifting and inserting palettes in a CNC machine (especially in a manufacturing process). Geometric tolerances, dimensioning, and GD&T are included in the 2D engineering drawings.

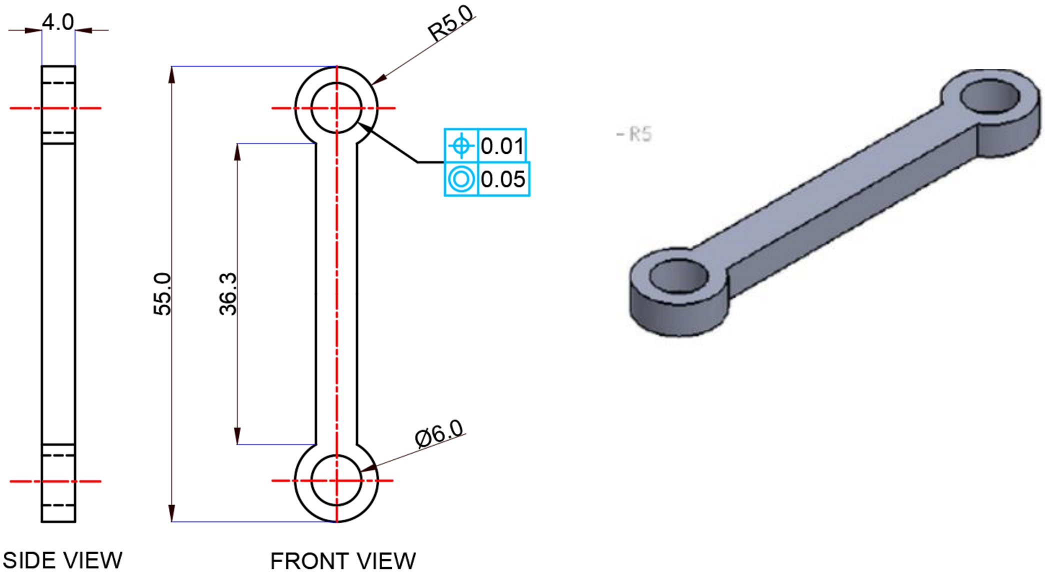
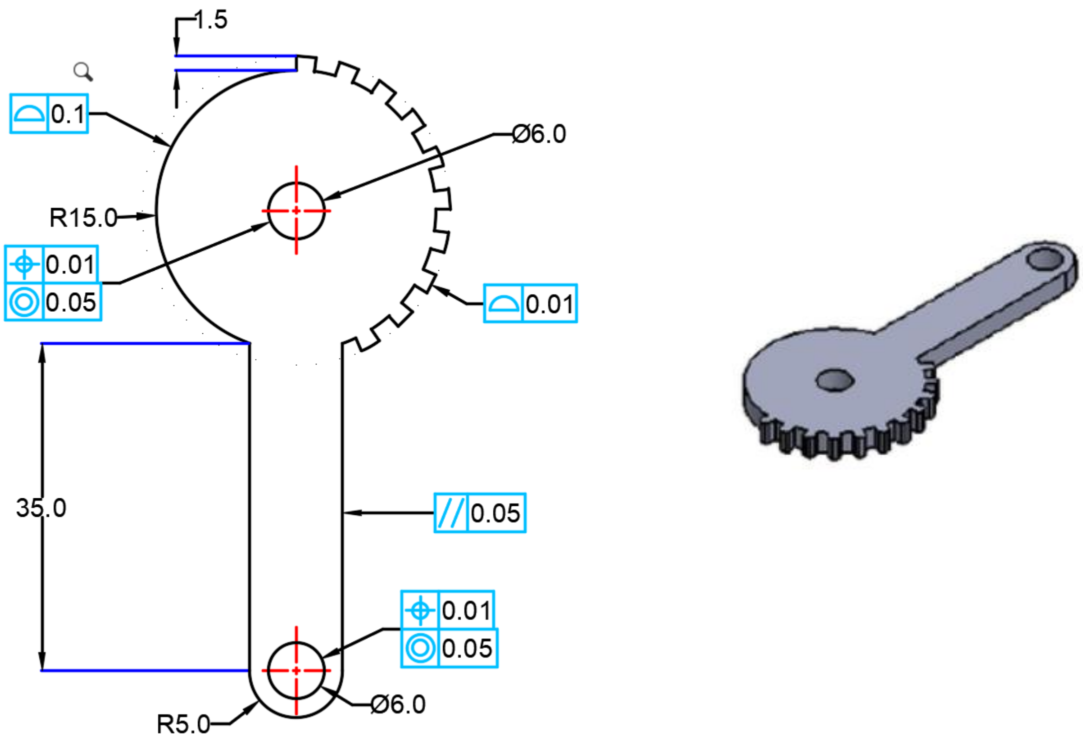


Fig.1 Connecting Rod



ALL DIMESNIONS IN MM

Fig.2 Geared Link

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

Exercise: 2. Orthographic top view of the robotic/ mechanical joints.
Joints: It connects two shafts/links and also provides support to hold the drive mechanism and actuator.

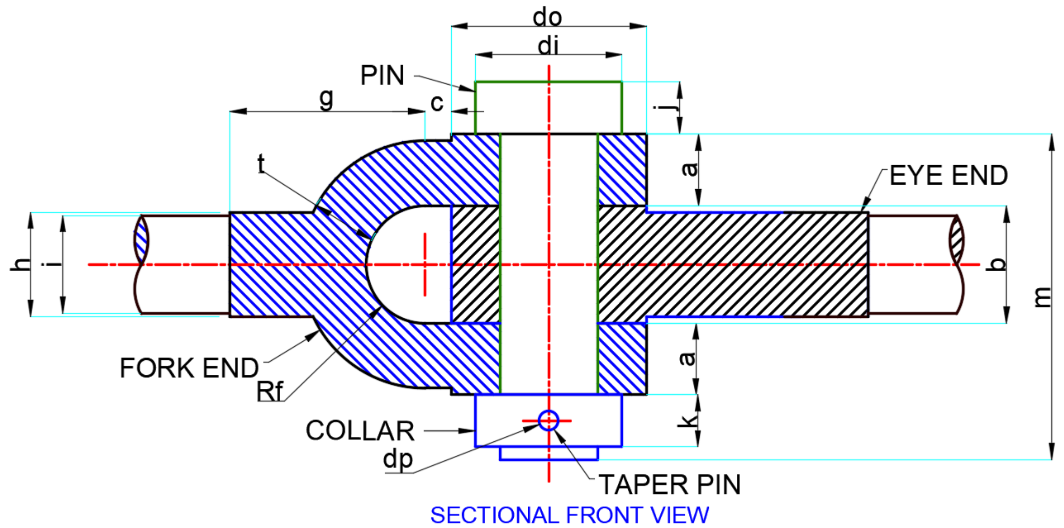


Fig.3 Knuckle joint

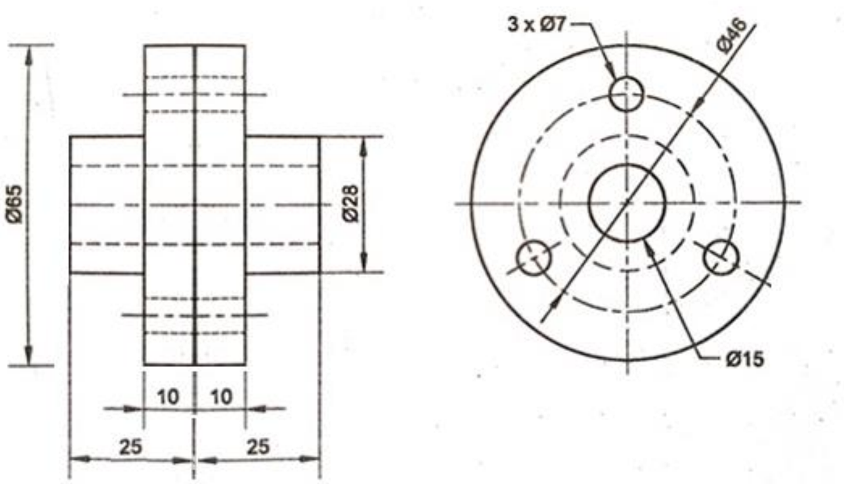


Fig.4 Flange (flange coupling main part)

Dimension Variable	Value (mm)
a	22
do	60
b	36
c	8
Rf	R18
t	20
di	45
g	60
h	32
i	30
J, k	16
dp	Φ6
m	100

ALL DIMESNIONS IN MM

Exercise: 3. Orthographic top view of the robotic/ mechanical gripper.

Gripper (End effector): Grippers are mainly used to hold and move objects from one place to another. The two finger gripper is that it is simple and multidisciplinary in its tasks.

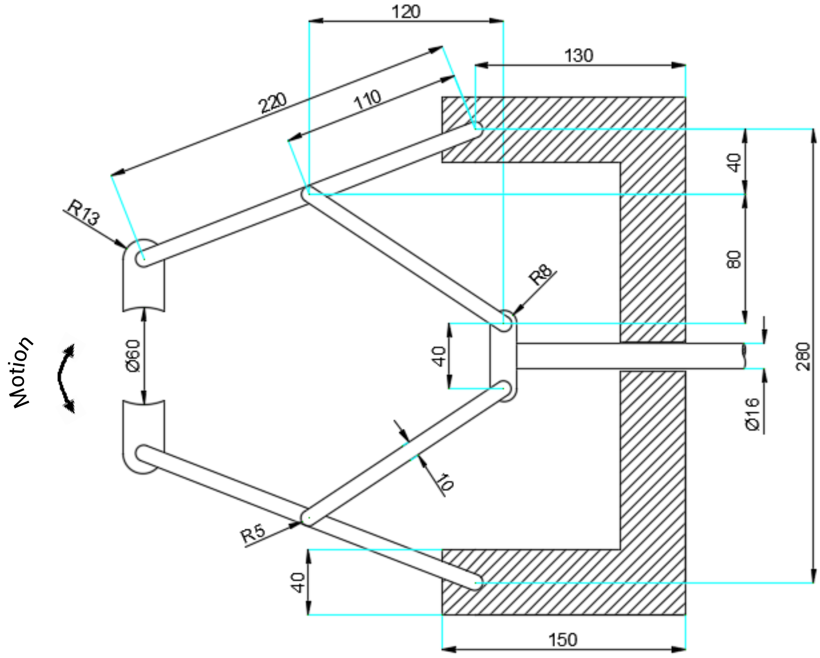


Fig.5. Two finger rotary motion gripper

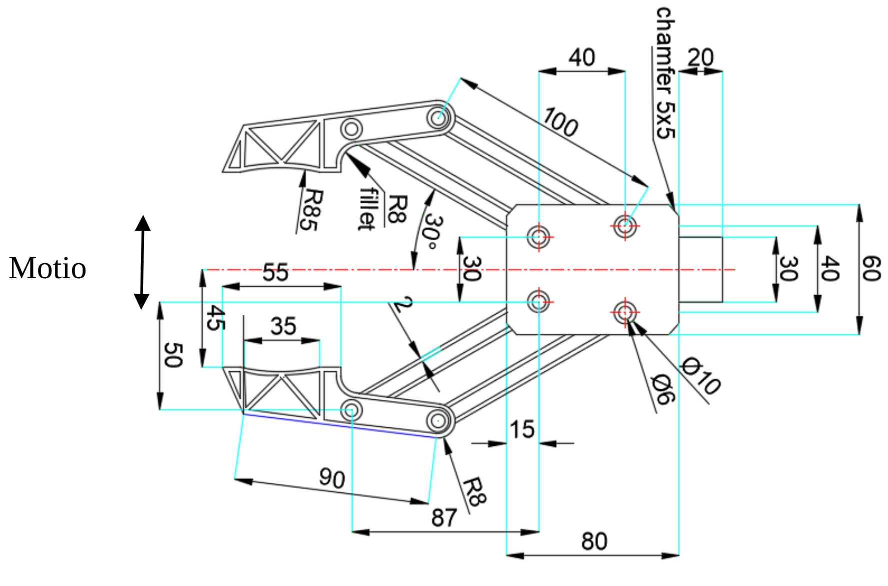


Fig.6. Two finger linear motion gripper

Exercise: 4. Orthographic view of any two threaded fasteners.

Threaded Fastener: *Screwed or threaded fasteners* such as machine screws, bolts and nuts are used to join *machine* parts. They allow for both permanent and removable connections.

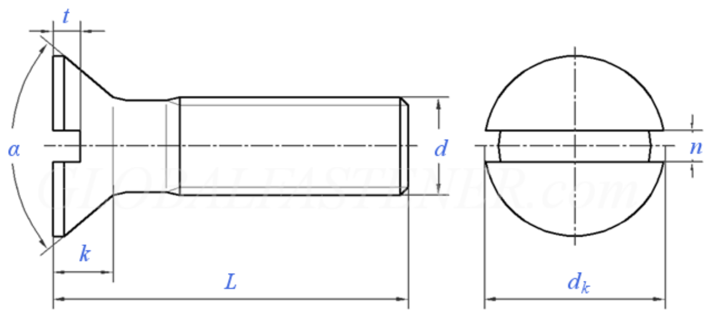
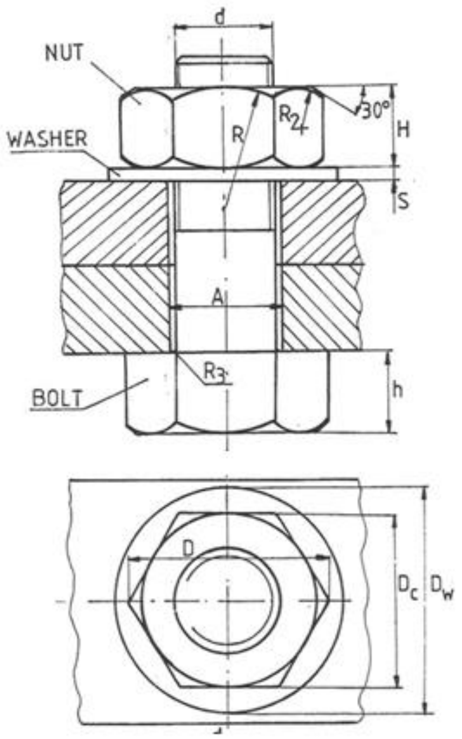


Fig.7. Slotted Flat Countersunk Head Machine Screw

Dimension	Description	mm
d	Nominal Thread Size	6.0
L	max	25.0
d_k	max	12.9
	min	11.5
k	max	2.7
	min	2.4
n	max	1.9
	min	1.6
t	max	1.2
	min	0.8
α	max	82°
	min	80°



d – nominal diameter

D – 1,7d

Dc – 1,5d

H = 0,6d

h = 0,7d

A = d + 1 mm

R = 1,5d

R_1 = d

R_2 = 0,4 d

R_3 = 0,1d

S = 0,15d

D_W = 2d

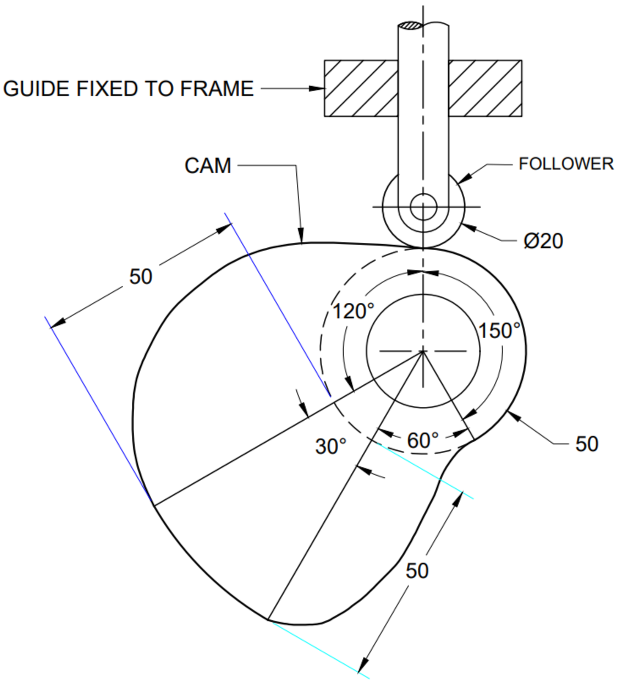
r = 1,25d

Fig.8. Hexagonal Bolt and Nut

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

Exercise: 5. 2D modeling of the cam and follower mechanism.

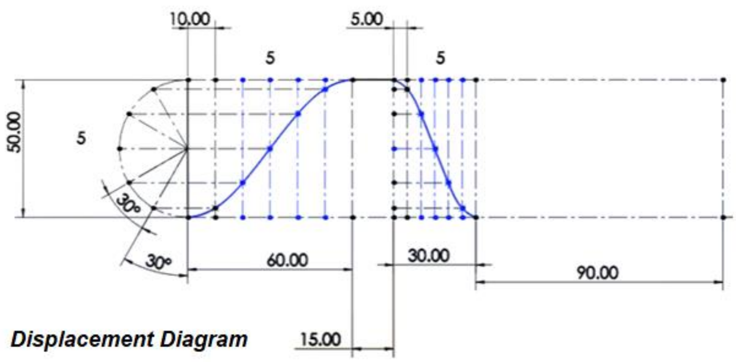
Cam and follower: A cam mechanism generally comprises three elements, a cam, a follower and a fixed frame. A cam is a component that gives a specific motion, by its rotation, to the follower. A follower is a component which is in reciprocating or swinging motion.



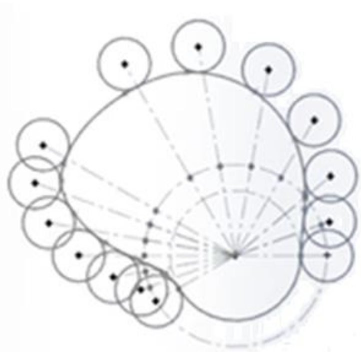
CAM
Minimum Radius= 25mm
CAM Shaft Diameter= 25mm
Rotation= 100 RPM Clockwise

Roller Follower- Inline with CAM Axis
Roller Diameter= 20mm
Stroke length= 50mm,
Motion During Raise & Lowering: SHM (Simple Harmonic Motion) 1. **Raise** 50mm during 120° Rotation of CAM 2. **Dwell** next 30° 3. **Lower** 50mm during next 60° 4. **Dwell** next 150°

Fig.9 CAM and Follower



Displacement Diagram

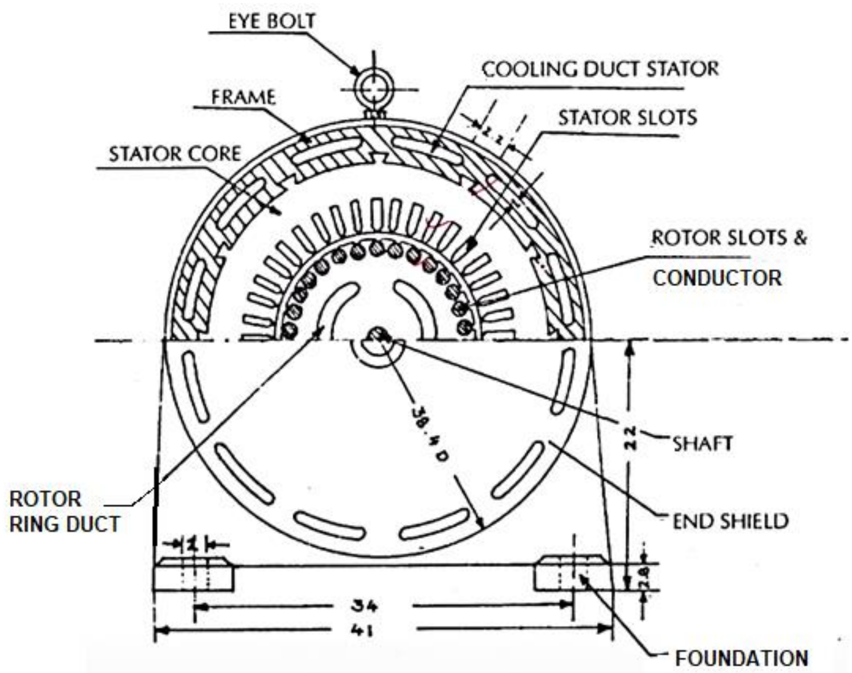


Cam profile is created by making tangency between spline and each circle

Fig.10 Steps involved in creating CAM

Exercise: 6 Draw the assembly of an induction motor end elevation top half in section.

Fig.11
Half



sectional side view of an induction motor

Exercise: 7 Create the single line diagram of electrical symbols (switch, wire, contactor, motor, transformer) using layers and block.

Single-Line Diagram: A diagram which shows, by means of single lines and electrical symbols, electric circuit or system of circuits and the component devices.

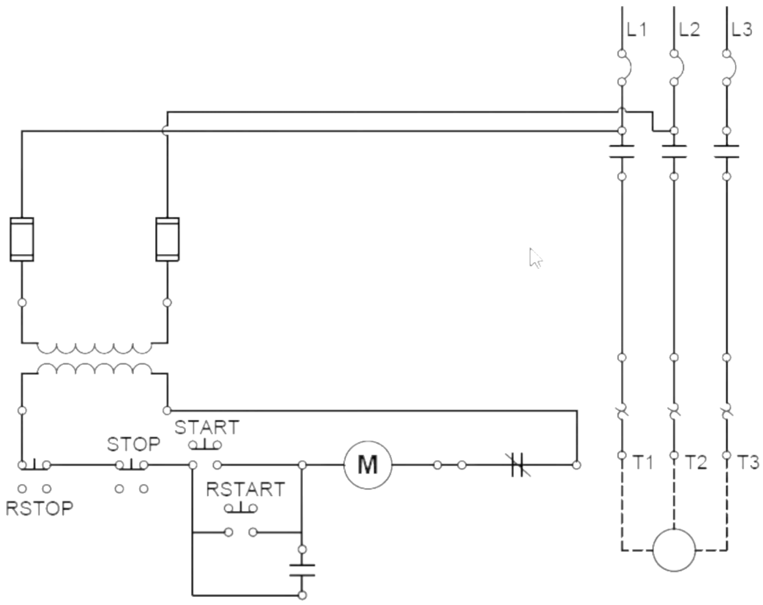


Fig.12 Electrical symbols in a circuit

1047233320	CAD FOR AUTOMATION	L	T	P	C
Practicum		0	0	4	2

Exercise: 8 Create a single-line diagram of an electrical circuit using the available components in the library or outsourcing on the web.

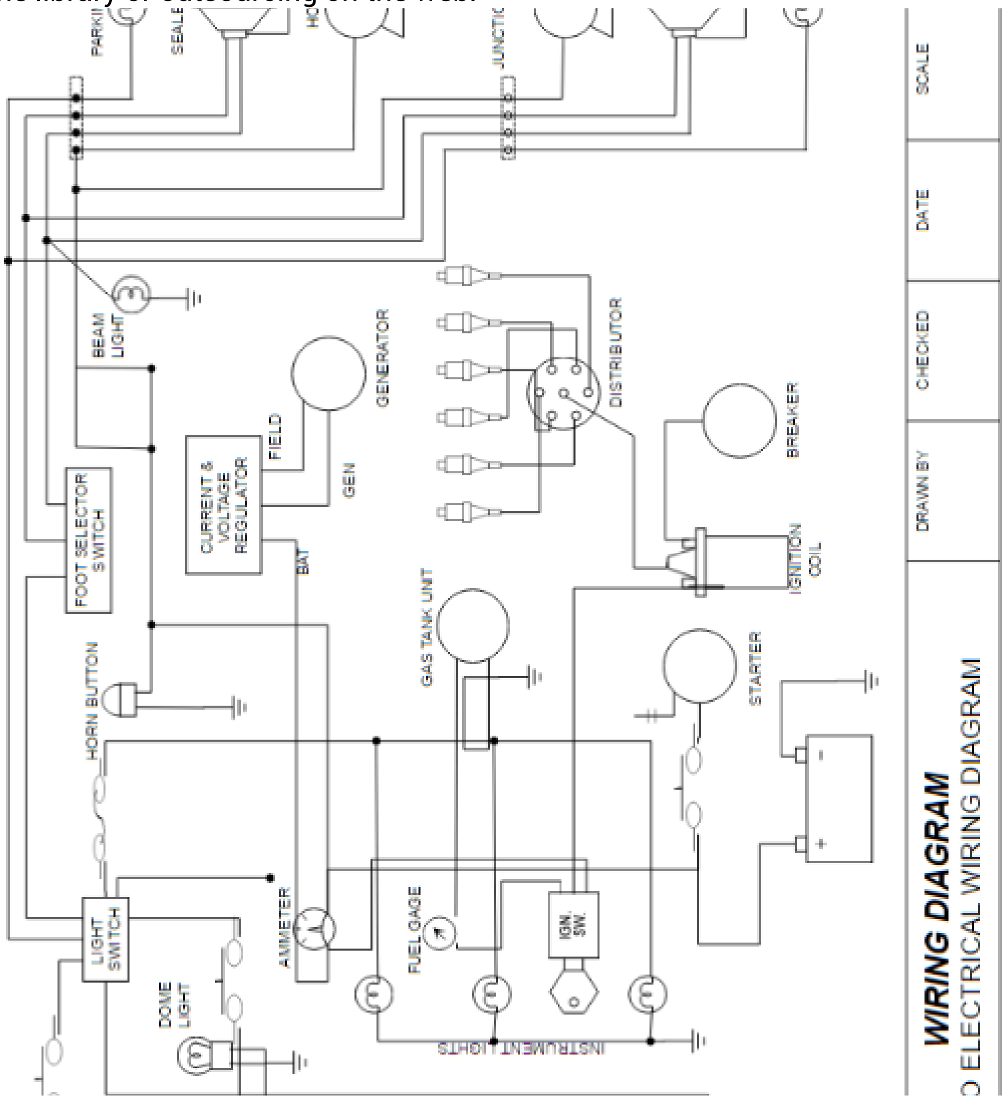
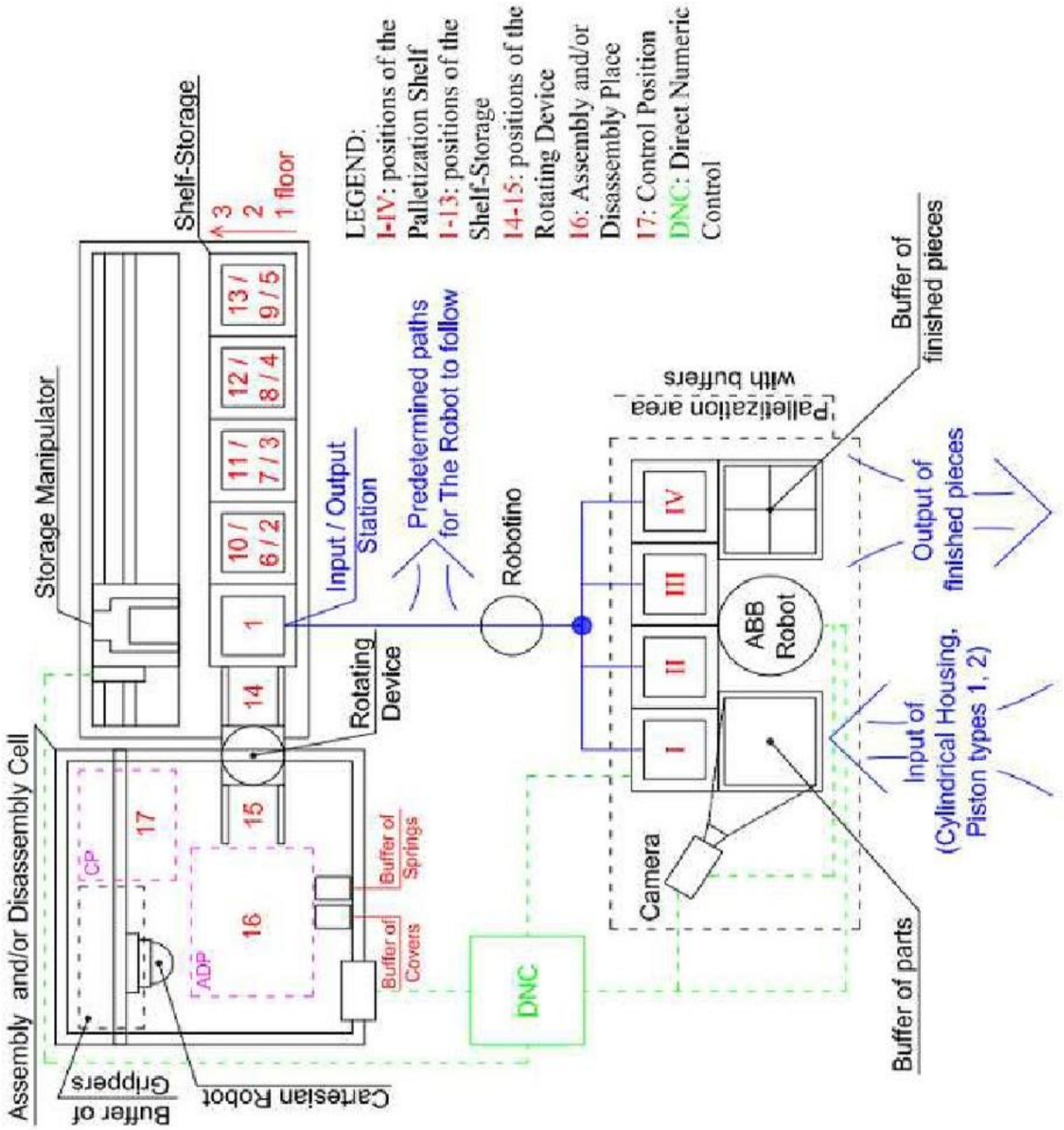


Fig.13 Auto electrical wiring diagram

Exercise: 9. Robotic work cell Layout/Plan using a block diagram

Robotic work cell: It is a complete system that includes the robot, controller, and other peripherals such as a part positioner (palletizer), storage manipulator (ASRS), CNC/DNC and safety environment.



Courtesy: Radovan Holubek, Slovak University of Technology

Fig.14 Detailed Robot work cell layout intended for the Intelligent manufacturing cell

Exercise: 10

Prepare a single line diagram of PLC panel wiring consists of the main breaker switch, bus bar, circuit breakers, relays, contactors, PLC, fuses, SMPS, terminal boards, utility sockets, and earthing points.

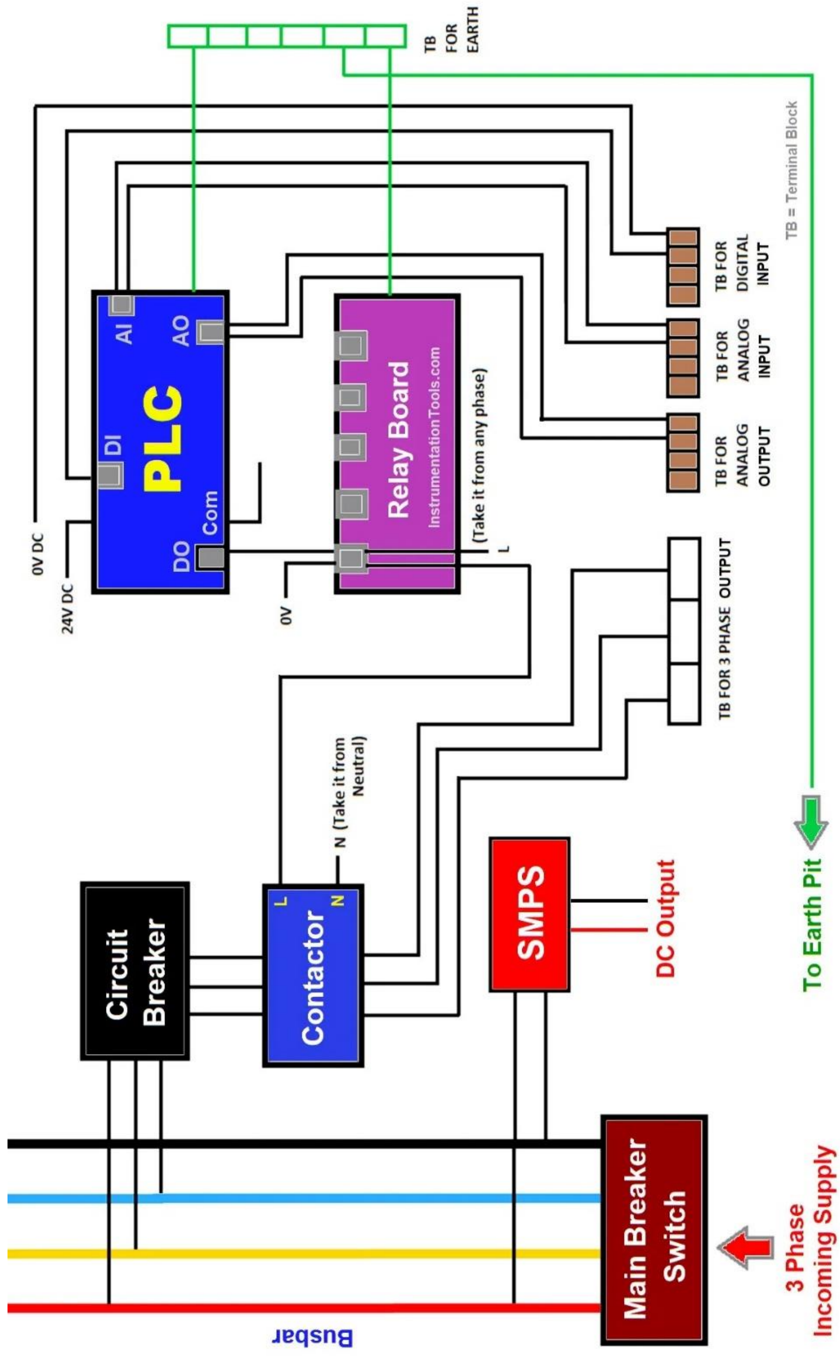


Fig.15 Wiring in PLC Panel

1047233420	C PROGRAMMING AND PYTHON	L	T	P	C
PRACTICAL		0	0	4	2

Introduction

To provide students with a solidunderstanding of Basic of C and Python's syntax, including variables, data types, control structures (such as loops and conditionals), functions, and modules. Through programming exercises students should develop problem-solving skills using C and Python. They should be able to apply C and Python concepts to solve real-world problems and implement algorithms efficiently.

Course Objectives

The objective of this course is to

- To read and write simple C and python programs.
- To define strings in python and operations on string.
- Represent compound data using python lists, tuples, and dictionaries.
- To define and access multi-dimensional arrays using NumPy.
- To do input/output with files in python.

Course Outcomes

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

CO1: Demonstrate the installation process of python IDE and modules

CO2: Implement the decision making and looping statements in python.

CO3: Define a regular expression for the pattern and verify for the validity.

CO4: Create and access string, list, tuple, dictionary and NumPy array.

CO5: Read and write text and csv file using python.

Pre-requisites

Basic principles and use of syntaxes of C and Python programming

1047233420	C PROGRAMMING AND PYTHON	L	T	P	C
PRACTICAL		0	0	4	2

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	-	-	-
CO2	3	3	3	3	-	-	-
CO3	3	3	3	3	-	-	-
CO4	3	2	3	3	-	-	-
CO5	3	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.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1047233420	C PROGRAMMING AND PYTHON	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 (Ex no 1 to 7)	Practical Test (Ex no 8 to 15)	Model Practical Exam.	Record of Work Done / Activity Report	Practical Examination
Duration	2hrs	2hrs	3hrs	Regularly	3 hours
Exam Marks	60	60	100	(100)	100
Converted to	15	15	15	10	60
Marks	15		15	10	60
Internal Marks	40				60

Note:

- CA1 and CA2: It should be conducted as per the end semester question pattern for 60 Marks. The 60 marks awarded will be converted to 15 Marks.
- The best one will be considered for the Internal Assessment of 15 Marks.
- CA 3: After completion of all the exercises, model examination should be conducted as per end semester question pattern.
- The marks awarded should be converted to 15 Marks for the internal assessment.
- CA 4: Record of work done should be maintained and the same have to be evaluated after completion of each practical exercise before the commencement of the next exercise for 10 Marks. (And / Or) The activity report should be completed and the same should be evaluated for 10 marks.
- The marks awarded should be converted to 10 Marks for the internal assessment.

1047233420	C PROGRAMMING AND PYTHON	L	T	P	C
PRACTICAL		0	0	4	2

Ex.No	Name of the Experiment	Periods
Part A		
1	Write a simple C Program a. Print your Name and Address b. Find Simple interest and Compound interest.	28
2	Write a C program to swap two variable's using (i) third variable and (ii) without using a third variable.	
3	Write a program to find the largest number between given three numbers.	
4	Write a program to print all prime numbers from 1 to N. i) Write a Python Program to print prime numbers in the given range ii) Write a Python Program to convert decimal to binary and octal	
5	i) Write a Python Program to check the given year is leap year or not. ii) Write a Python Program to print Armstrong numbers between given range.	
6	Write a Python program function for display calendar	
7	Write a Python Program using recursion to print 'n' terms in Fibonacci series. Write a Python Program using without recursion to print 'n' terms in Fibonacci series	
PART - B		
8	Write a program to prepare the total marks for N students by reading the Reg. No, Name, and Mark1 to Mark6 by using array of structures.	32
9	Write a program using the function power (a,b) to calculate the value of a raised to b	
10	Write a program to find the length of the given string using pointers	

11	Write a program to find factorial of a number using recursion.	
12	Write a Python Program to make a simple calculator	
13	Write a Python Program to take a list of words and return the length of the longest one using string.	
14	Write a Python Program to copy file contents from one file to another and display number of words copied	
15	Write a Python Program to demonstrate to use Dictionary and related Functions.	
TOTAL HOURS		60

DETAILLED ALLOCATION OF MARKS

SCHEME OF VALUATION	
Writing answer for any one program from PART – A	20 Marks
Execution (Part A)	20 Marks
Result with Print out (Part A)	05 Marks
Writing answer for any one program from PART – B	25 Marks
Execution (Part – B)	20 Marks
Result with Print out (Part – B)	05 Marks
VIVA-VOCE	05 Marks
TOTAL	100 Marks

NOTE:

Students should write one program from PART A and one program from PART B.

1047233420	C PROGRAMMING AND PYTHON	L	T	P	C
PRACTICAL		0	0	4	2

LIST OF EQUIPMENTS

Hardware Requirements

1. Desktop Computers – 30 Nos
2. Laser Printer – 1 No

Software Requirement:

1. Windows / Linux Operating System
2. Python (to run as interactive mode and IDLE mode)
3. Code Blocks /Turbo C

Note:

Submission of Practical Log / Observation book for the model practical exam is mandatory.

Allocation of Marks for CA 1 & CA 2 and CA 3 Tests

Section	Description	Marks
1	Aim& Program	40
2	Execution and result	20
TOTAL MARKS		60

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1047233540	MANUFACTURING TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

Introduction: To meet out Globalization, technological advances and to sustain we have to explore the knowledge about machine tools covering the various operations and skill set required for the development of nation and its people.

Course Objectives:

1. Expose to the Concept and Basic Mechanics of Metal Cutting
2. Familiarize with working of Standard Machine Tools such as Lathe and Milling.
3. Familiarize with working of Grinding Process.

Course Outcomes:

CO1: Understand the concept and basic Mechanics of Metal Cutting.

CO2: Know the working of Machine tools and demonstrate the need of such Machine Tools for sustainable development.

CO3: Know the operations on Lathe Machine and demonstrate the need of such Machine tools for sustainable development.

CO4: Know the operations on Milling Machine and demonstrate the need of such Machine tools for sustainable development.

CO5: Selection of Grinding process for an application and understand the impact of Process in environmental context.

CO/PO Mapping

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

1047233540	MANUFACTURING TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	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.

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II 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 Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				

1047233540	MANUFACTURING TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical documents 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.

  The details of the documents to be prepared as per the instruction below.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Tools required	5
B	Preparation / Procedure	15
C	Operation / Machining / Dimensions	20
D	Surface Finishing	10
TOTAL		50
E	Practical Documents (As per the portions)	10
		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.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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	ACTIVITY	MARKS
A	Aim & Tools required	10
B	Procedure	20
C	Preparation	20
D	Lathe/Milling/Grinding	20
E	Accuracy / Tool Handling / Finish / Result	20
F	Viva Voce	10
	TOTAL	100

1047233540	MANUFACTURING TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion / Introduction	Period
Unit 1 **Lathe -** Introduction - specifications – Types of Lathe – Tool & Work Holding Devices – Nomenclature of Single Point Cutting Tool - machining operations done on lathe. **Unit-II** **Milling** – Introduction – Specification – Types of Milling Machines – Tool & Work Holding Devices – Milling Operations - Milling cutters classification only-Milling operations-types-straddle milling - gang milling. Indexing-Indexing plate – Indexing methods - simple indexing, differential indexing **UNIT-III** **Grinding** Grinding Process – Cylindrical Grinding, Surface Grinding, Grinding-principles of operation only. – grinding wheels – abrasives - natural and artificial diamond wheels - types of bonds - grit, grade and structure of wheels - wheel shapes and sizes - standard marking systems of grinding wheels - Dressing and Truing of wheels	15
Practical Exercises **I. LATHE** 1. Grooving and Taper Turning. 2. LH Thread cutting. 3. RH Thread cutting. 4. Eccentric Turning. 5. Bush: Turning & Drilling **II. MILLING MACHINE** 6.Make Spur Gear using milling machine by simple Indexing 7.Make helical gear using milling machine	60

III. GRINDING 8.Grind a plain surface using surface Grinder 9. Make progressive type plug gauge using cylindrical grinding machine 10. Make a turning tool / milling cutter using tool and cutter grinder.	
Total	**75**

Suggested List of Students Activity:

1. Observe the Lathe machine in the institute and study its specifications.
   List the possible operation that can be done on that machine.
2. Observe the machine tools such as Milling machine of the institute and study its specifications.
3. Observe the cylindrical Grinding machine of the institute and study its specifications.
   List the possible operation that can be done on that machine.
4. Justify why lathe machine is called mother of all machines.

Text and Reference Books:

1. Elements of workshop Technology Volume I & II – Hajra Chowdry & Bhattacharaya - IIth Edition - Media Promoters & Publishers Pvt. Ltd.,
2. A Textbook of workshop Technology - R.S.Khurmi & J.K.Gupta - 2nd Edition, S.Chand & Co., Ram Nagar, New Delhi – 2018.
3. Manufacturing process – Begeman - 5th Edition -McGraw Hill, New Delhi 2011.
4. Workshop Technology- WAJ Chapman - Volume I, II, & III – Vima Books Pvt. Ltd., 4262/3, Ansari Road, Daryaganj, New Delhi 110 002.

Web-based/Online Resources:

- **NPTEL (National Programme on Technology Enhanced Learning)**: Offers video lectures and course materials on lathe operations
- **Virtual Labs - IIT Delhi**: Interactive simulations and resources on lathe machining operations.

1047233540	MANUFACTURING TECHNOLOGY	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.	Lathe	10 Nos.
2.	Universal Milling Machine	2 Nos.
3.	Surface Grinding Machine	1 No
4.	Cylindrical grinding machine	1 No
5.	Tool and Cutter Grinder Machine	1 No
6.	Safety Glass	10 nos
7.	Consumables	Sufficient quantity

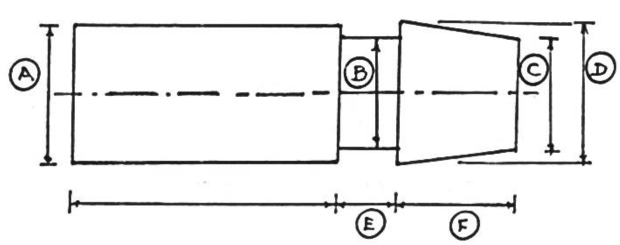
Exercises drawing:

All the dimensions are in mm.

I. LATHE

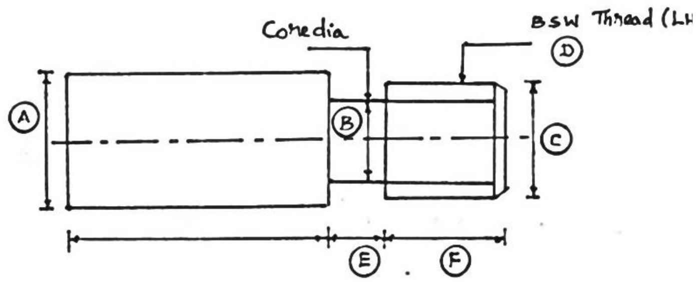
Make the following jobs in the lathe. Raw material :______ M.S. Round Rod

1. Grooving and Taper Turning.

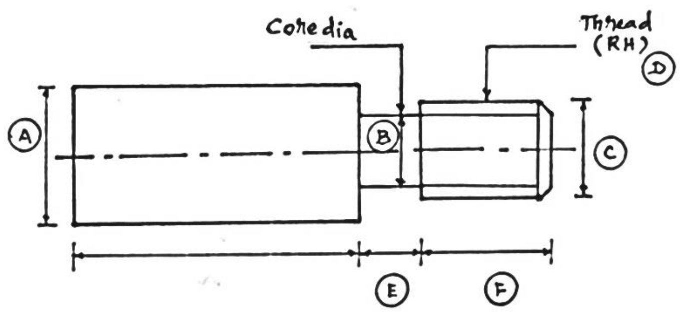


Dimensions			
Sl.No	Part Name	Actual	Obtained

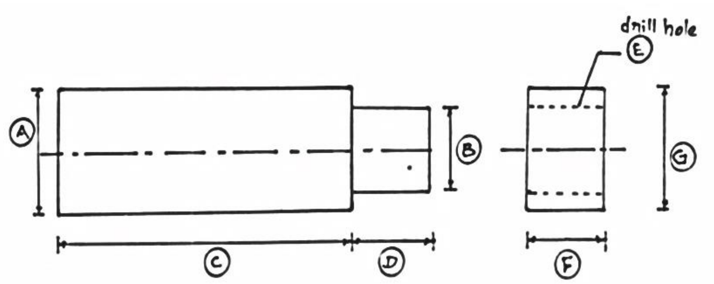
2. LH Thread cutting.



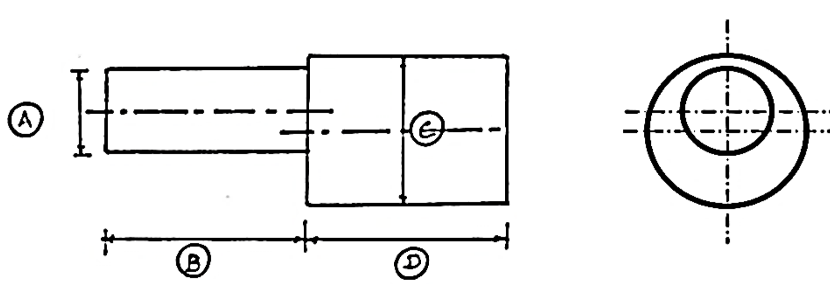
3. RH Thread cutting.



4. Bush: Turning & Drilling



5. Eccentric Turning.

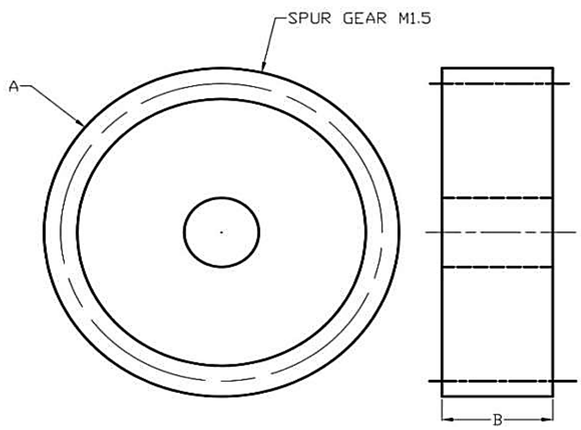


II. MILLING

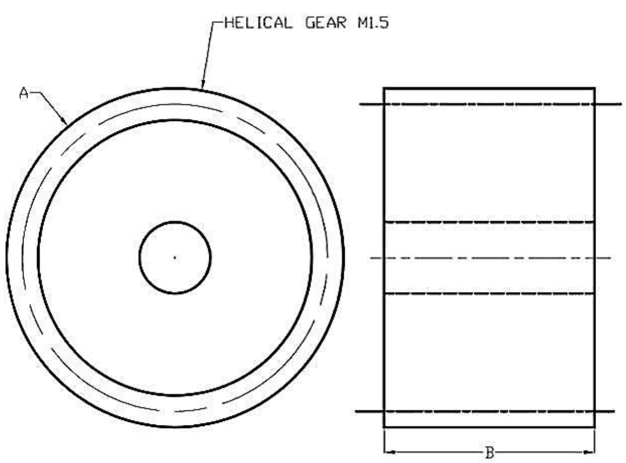
Make the following jobs in the milling machine.

Raw material :______ M.S. Round Rod

6. Make Spur Gear using milling machine by simple Indexing



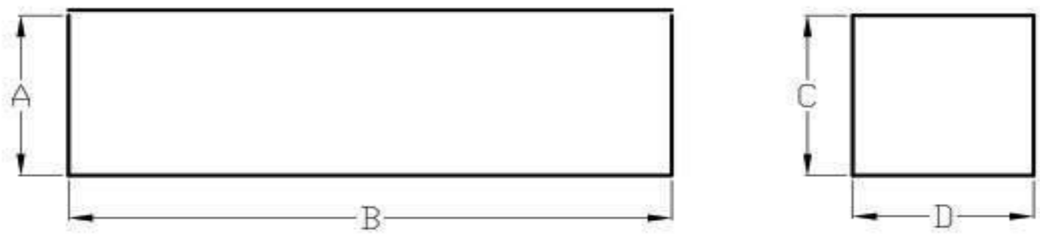
7. Make helical gear using milling machine



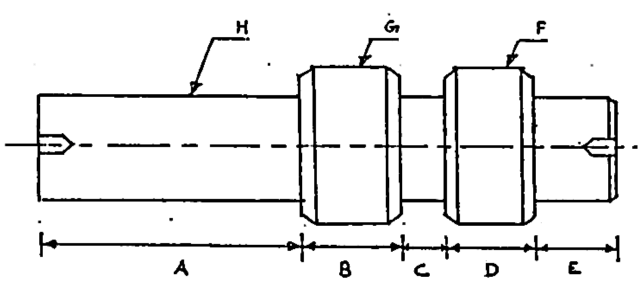
III. GRINDING

Make the following jobs in the Grinding machine using given raw material.

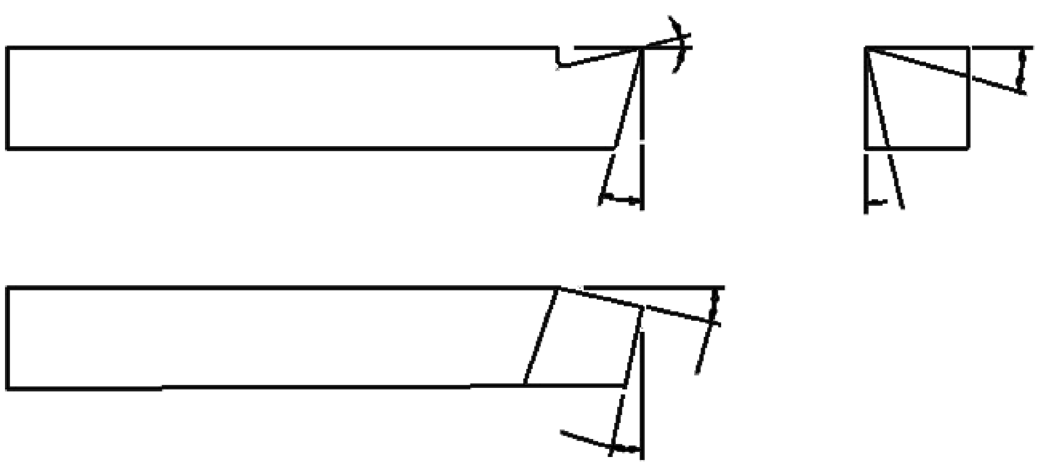
8. Grind a plain surface using surface Grinder



9. Make progressive type plug gauge using cylindrical grinding machine



10. Make a turning tool / milling cutter using tool and cutter grinder.



1047233640	INTRODUCTION TO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Mechatronics is an interdisciplinary field that integrates mechanical engineering, electronics, computer science, and control engineering to design and create intelligent systems and products. This subject covers the fundamental principles and technologies used in the development of modern automated systems. Lectures are intended to provide the student with foundational concepts in mechatronics and practical familiarity with common elements making up mechatronic systems. Laboratory experiments are designed to give the student hands-on experience with components and measurement equipment used in the design of mechatronic products. Develop an understanding of the basic elements underlying mechatronic systems

Course Objectives:

The objective of this course is to enable the student to

- Understand of the fundamental principles of electrical circuits in mechatronics system.
- Equip students with a thorough understanding of the construction, operation, and V-I characteristics of various semiconductor devices including diodes, Zener diodes, BJTs, FETs, UJTs, SCRs, TRIACs, and DIACs
- Introduce students to the fundamentals of mechatronics, encompassing its definition, evolution, and multidisciplinary nature
- Identify the elements of mechatronics system through theoretical knowledge and practical experiments.

Course Outcomes:

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

CO1 : Apply Ohm's Law and Kirchhoff's laws to solve complex resistive circuits, including series and parallel configurations.

CO2 : Analyze RL, RC, and RLC series circuits to determine impedance, phase angle, and draw phasor diagrams.

CO3 : Explain the construction, and V-I characteristics of diodes, Zener diodes, BJTs, FETs, UJTs, SCRs, TRIACs, and DIACs

CO4 : Identify and describe the applications of these semiconductor devices in electronic circuits

CO5 : Define Mechatronics and Interpret block diagrams of mechatronic systems, detailing the roles of information, mechanical, electrical, and computer systems, as well as sensors and actuators.

Pre-requisites:

CO/PO Mapping

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

1047233640	INTRODUCTION TO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

- 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

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II 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 Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents 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.

- 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.
- CA 4: 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim	5
B	Circuit Diagram	10
C	Connection	10
D	Observation/Tabulation/Calculation	10
E	Result	5
TOTAL		50
E	Practical Documents (As per the portions)	10
		60

1047233640	INTRODUCTION TO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Aim	10
B	Circuit Diagram	20
C	Connection	20
D	Observation/Tabulation/Calculation	20
E	Result	20
F	Viva Voce	10
	TOTAL	100

1047233640	INTRODUCTION TO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Theory:	
Fundamentals of Electricals	**Period**
Resistive elements - Ohm's Law - Kirchhoff's laws - Resistors in series and parallel circuits - Mesh Analysis - Node Analysis - Problems on all the above topics. 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 Significance of 3 phase circuits – Star, Delta connections- Relation between voltages, currents of line and phase values in star and delta connection	15
Fundamentals of Electronics	
Construction and V-I characteristics of : Diode, Zener Diode, BJT, FET, UJT, SCR, TRIAC, DIAC – Applications - Full Wave Bridge Rectifier With & Without filter – Zener Diode as Voltage Regulator - Common Emitter, Common Base and Common Collector Configuration of BJT – Common Source FET Amplifier.	
Mechatronics System	
Definition of mechatronics - Evolution of mechatronics systems - Multidisciplinary nature - Basic building blocks of mechatronic systems. Block diagram and Key Elements of Mechatronics System: Information Systems, Mechanical Systems, Electrical Systems, Computer Systems, Sensors and Actuators, Real Time Interfacing. Application of Mechatronics in Automobiles, Manufacturing System, Medical.	

1047233640	INTRODUCTION TO MECHATRONICS	L	T	P	C
PRACTICUM		1	0	4	3

Practical Experiments:		
Ex.No	Name of the Experiment	Period
1.	Calibration of Ammeter , Voltmeter, Wattmeter	60
2.	Verify Superposition Theorem	
3.	Verify Maximum Power Transfer Theorem	
4.	Analyse voltage current relationship in series RL,RC,RLC circuit through simulation.(Any open end software)	
5	Simulation to Calculate Impedance in a Series RLC Circuit and Verify Theoretically. (Any open end software)	
6.	Measurement of power and power factor of single phase load and plot the graph	
7.	Measurement of three phase power using two wattmeter	
8.	Construct the circuit and Obtain the VI Characteristics of PN Junction Diode and Zener Diode.	
9.	Construct the circuit and Obtain the Input and Output Characteristics of BJT in CE Configuration.	
10	Conduct an experiment to demonstrate the operation of an SCR as an switch.	
11	Identifying the Electrical, mechanical, and electronic Circuits available in an Automobile/Industrial Robot/Washing Machine	
12	Built a Creative Toy Using the Electrical, Mechanical and Electronics components	
TOTAL PERIODS		75

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. Electric circuit theory by Dr. M. Arumugam & N. Prem kumar, Khanna Publishers New Delhi
2. Mehta, V.K. and Mehta, R., *Basic Electrical Engineering*, 6th Edition, S. Chand Publishing, 2017.
3. Salivahanan, S. and Kumar, N. Suresh, *Electronic Devices and Circuit Theory*, 1st Edition, McGraw Hill Education, 2015.
4. Rajput, R.K., *Mechatronics*, 1st Edition, S. Chand Publishing, 2007.
5. Mechatronics: Principles and Applications by Godfrey C. Onwubolu

Web-based/Online Resources:

- https://nptel.ac.in/courses/122106025- Basic Electronics
- https://onlinecourses.nptel.ac.in/noc20_ee64/preview- Electrical Circuits
- https://onlinecourses.nptel.ac.in/noc21_me27/preview - Mechatronics

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.	Discrete Components: PN Junction Diodes, Zener Diode, FET, UJT, BJT, Resistors and Capacitors	As required
6.	DC Voltmeter (Analog/Digital) – Different Ranges	5 Nos

7.	DC Ammeter (Analog/Digital) – Different Ranges	5 Nos
8.	Industrial Robot/Washing Machine/Automobile	1 No

Regulation2023

Program Structure

Diploma in Mechatronics

IV SEM SYLLABUS

1047234110	MICROCONTROLLER AND INTERFACING	L	T	P	C
THEORY		4	0	0	4

Introduction:

The introduction of this subject will enable the students to learn about microcontroller 8051 architecture, Instruction sets, Programming and interfacing. This subject enables the students to do the project effectively. It also helps the students to choose the field /of interest. If the student is aiming for higher studies, this subject is foundation.

Course Objectives:

- To differentiate microprocessor and microcontroller, architecture of 8051.
- To learn the Instruction set and write programs using 8051 ALP.
- To learn the programming of I/O ports, Timer, Interrupt and Serial Programming.
- To learn the interfacing techniques.
- Understand ARM7 processor.
- Understand the architecture of LPC 2148.

Course Outcomes:

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

CO1: Describe the architectural and operational configuration of 8051 microcontroller

CO2: Develop assembly language programs using 8051 Instructions.

CO3: Describe the timer, serial port and interrupt facility in 8051.

CO4: Discuss the interfacing techniques.

CO5: Know the Embedded System & Arm 7 processor

Pre-requisites:

Knowledge of basic science and simple programming.

CO/PO Mapping:

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

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.

Assessment Methodology:

	Continuous Assessment (40 Marks)				End Semester Examination (60 Marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test 1	Written Test 2	Quiz / MCQ	Model Examination	Written Examination
Portion	Unit I & II	Unit III & IV	All Units	All Units	All Units
Duration	2 Hours	2 Hours	1 Hour	3 Hours	3 hours
Exam Marks	60	60	40	100	100
Converted to Marks	20	20	10	10	60
Internal Marks	40				60

Note:

CA1 and CA2 Assessment test should be conducted. Best of one will be considered for the internal assessment of 20 Marks.

CA3 Online quiz examination (MCQ) should be conducted covering the complete syllabus. The marks should be converted to 10 marks for the internal assessment

1047234110	MICROCONTROLLER AND INTERFACING	L	T	P	C
THEORY		4	0	0	4

CA4 Model examination should be conducted as per the end semester question pattern. The marks should be converted to 10 marks for the internal assessment.

UNIT–I ARCHITECTUREOF8051MICROCONTROLLER	
Microprocessor-Microcontroller-Comparison of microprocessor and microcontroller-Key Features of 8051- Architecture diagram of microcontroller 8051-Functions of each block-Pin details of 8051- Memory Organization of 8051 -Special function registers-Program counter-PSW register- I/O ports-Timer-Interrupt-serial port.	12
UNIT–II 8051INSTRUCTIONSETANDPROGRAMMING	
Instruction set of 8051-Classification of 8051 instructions-data transfer instructions-Arithmeticinstructions-Logicalinstructions-Branchinginstructions- Bit manipulation instructions– Assembler Directives-DifferentAddressingmodesof8051-Timedelay routines Assembly language programs - 16 bit addition -8 bit multiplication - BCD to HEX code conversion- Smallest number	12
UNIT–III 8051 PERPHERALS	
I/O Ports-Bit addresses for I/O ports- I/O port programming-I/O bit manipulation programming. Timer/Counter-SFRS for Timer-Modes of Timers/counters-Programming 8051 Timer (Simple programs). Serial Communication-SFRs for serial communication-RS232standard- 8051 connection to RS 232-8051 serial port programming. Interrupts-8051interrupts-SFRsforinterrupt-Interruptpriority	12
UNIT–IV REAL WORLD INTERFACING	
IC8255-Block diagram-Modes of 8255-8051 interfacing with 8255 Interfacing - Relay interfacing- Sensor interfacing -Seven segment LED display interfacing -Stepper motor interfacing-ADC interfacing- DAC interfacing - DC motor interfacing using PWM.	12
UNIT–V INTRODUCTION TO EMBEDDED SYSTEMS AND ARM PROCESSOR	
Embedded Systems -Definition of Embedded System – Features of Embedded System – Types of Embedded System – List of Embedded System Devices-Harvard and Von-Neumann architectures-RISC and CISC Processor. Introduction to LPC 2148 ARM controller - LPC 2148 ARM Controller Features-Block	12

diagram – Applications	

Suggested List of Students Activity:

Lectures with discussions, question and answer sessions, informal quizzes, video sessions where students have an opportunity to clear concepts and doubts. E – Resources and E-Learning for the virtual learning environment to prepare the students ready for each and every circumstance. Presentation / Seminars by students on any recent technological developments based on the course.

TEXT BOOKS

1. Mazidi M.A., Mazidi J.G., McKinlay R.D., The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd edition, Pearson Education, 2006.
2. Ayala K.J., The 8051 Microcontroller: Architecture, Programming, and Applications, 3rd edition, Cengage Learning, 2007.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson Education India, 2011.
4. Subrata Ghoshal, 8051 Microcontroller: Internals, Instructions, Programming & Interfacing, Pearson Education India, 2010.

Web reference:

- cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf
- www.nrtec.in/wp-content/uploads/2023/09/EMBEDDED-SYSTEMS.pdf
- The 8051 Microcontroller PDF
- ARM7 Based LPC2148 Microcontroller Pin Configuration
- Embedded Systems PDF

1047234230	LOW COST AUTOMATION	L	T	P	C
PRACTICUM		3	0	2	4

Introduction:

Fluid power automation, encompassing hydraulic and pneumatic systems, is widely adopted in various industries due to its numerous advantages.

Hydraulic systems can generate a significant amount of power relative to their size and weight. This makes them suitable for applications requiring high force and torque in compact spaces, such as heavy machinery and construction equipment.

Pneumatic and hydraulic systems offer precise control over force, speed, and movement. This precision is essential in applications like robotics, material handling, and manufacturing, where accuracy is crucial for performance and safety.

These benefits make fluid power systems an essential component in modern automation across various industries.

Course Objectives

On successful completion of the course, the students must be able to

1. Understand the basic concepts and principles of industrial automation.
2. Explain the role of automation in modern manufacturing and production processes.
3. Understand the basic principles of fluid power.
4. Understand the need fora Hydraulics and Pneumatics system in industries.
5. Explain the working principles of Pneumatic components and their selection.
6. Explain the working principles of Hydraulic components and their selection.
7. Develop a Hydraulic and Pneumatic control circuit for various industrial applications.
8. Develop practical skills through hands-on lab exercises, including assembling, testing, and troubleshooting hydraulic and pneumatic circuits

Course Outcomes

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

CO1: Explain the role of automation in modern manufacturing and production Processes.

CO2: Demonstrate a thorough understanding of the fundamental principles of Hydraulics and pneumatics.

CO3: Design basic to complex hydraulic and pneumatic circuits, demonstrating an understanding of system requirements and constraints

CO4: Analyze and interpret fluid power schematics and diagrams to troubleshoot and optimize system performance

CO5: Implement various control methods for fluid power systems, including manual, . electrical, and electronic controls.

Pre-requisites

Knowledge about the behavior of fluids.

CO/PO Mapping

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

Instructional Strategy

1. Massive open online courses (MOOCs) may be used to teach various topics.
2. The topics that are relatively simpler or descriptive are to be given to the students for self-directed learning and assess the outcomes through classroom seminars or group discussions.
3. Teachers must ensure to create opportunities for co-curricular activities.
4. Videos and simulations may be used to teach various topics.
5. Encourage students to refer to different textbooks and case studies to have deeper understanding of the subject.
6. Observe and continuously monitor the performance of the student in the laboratory.
7. Instruct students about safety concerns of fluid power systems and avoid any damage to the components.

1047234230	LOW COST AUTOMATION	L	T	P	C
PRACTICUM		3	0	2	4

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test Theory (Any Two Units)	Written Test Theory (Another Two Units)	Practical Test (All Exercises)	Written Test (Complete Theory Portions)	Written Examination (Complete Theory Portions)
Duration	2	2	3	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** Assessment written test should be conducted for 50 Marks. The marks scored will be converted to 10 Marks for each test. Best of one will be considered for the internal assessment of 10 Marks.

  CA1 and CA2, Assessment written test should be conducted for two units as below.

  PART A: (5 X 10 Marks = 50 Marks).

  Eight questions will be asked, students should write Five questions.

  Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

- **CA 3:** 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 practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 15 Marks for the internal mark.

Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. Each exercise/experiment should be evaluated for 10 Marks. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

The details of the documents to be prepared as per the instruction below.

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Circuit Diagram	20
B	Connection and Execution	30
C	Result	10
D	Practical document (All Practicals)	30
E	Viva Voce	10
	Total	100

CA4: Model examination should be conducted for complete theory portions as per the end semester question pattern. The marks awarded should be converted to 15 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1047234230	LOW COST AUTOMATION	L	T	P	C
PRACTICUM		3	0	2	4

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Unit I	Introduction to Fluid Power Automation	
Introduction to Automation – Definition - Need for Automation - Elements of an Automated System - Benefits and Impact of Automation in Manufacturing and Process Industries - Types of Automation (Fixed/Hard Automation, Programmable Automation, Flexible/Soft Automation) - Industrial Control Systems (Continuous, Discrete, Sequential logic, Supervisory) – Hierarchy of industrial automation systems (Five Layer Pyramid) - Low-cost automation (Brief introduction, features and benefits only)Fluid Power System: Definition, Types, Application and Advantages of Fluid Power – Illustration of Pascal's Law - Comparison of Hydraulics and Pneumatics – Fluid Properties (Density, Specific Gravity, Specific Weight, Viscosity, Kinematic Viscosity, Bulk Modulus, Pour Point, Oxidation Resistance)		9
UNIT II	HYDRAULIC PUMPS AND ACTUATORS	
Hydraulic Pumps and Actuators: Pumps: Classification of pumps – Principle of Positive displacement pumps – Construction and Working of External Gear pumps, Balanced Vane pumps and Inline Axial Piston pump – Pump Performance Characteristics – Pump selection factors – Accumulator and Types – Gas loaded accumulator – Pressure intensifier Actuators: Classification of actuators – Linear actuator: Definition and Types – Single acting cylinder– Telescopic cylinder – Tandem cylinder. Rotary actuators: Definition and Types – Gear motor – Two vane semi rotary actuator – Rack and Pinion semi rotary actuator.		9

ISO symbols of hydraulic pumps and actuators.		
UNIT III	HYDRAULIC CONTROL COMPONENTS AND HYDRAULIC CIRCUIT DESIGN	
Control Valves: Classification of valves – Comparison of Poppet Valve, Sliding Spool and Rotary Spool Valves DCV: Two-way valve – Three-way valve – Four-way valve – Check valve – Valve actuation types. FCV: Needle valve PCV: Pilot operated Pressure relief valve – Pressure sequence valve Hydraulic Circuit Design: Control of single acting cylinder – Control of double acting cylinder – Counterbalance circuit – Pressure sequence circuit – Hydraulic regenerative circuit – Pressure intensification circuit.		9
Ex.No	Name of the Experiment	
1	Control of single acting cylinder	12
2	Control of double acting cylinder	
3	Speed control of double acting cylinder	
4	Pressure sequence circuit	
Unit IV	PNEUMATIC SYSTEM	
Pneumatic system: Basic principle and its structure - Compressor Types – Two stage piston Compressor –Air treatment – FRL unit – 5/2 DCV – Double pilot dcv - Quick exhaust valve – Shuttle valve – One way FCV - Pneumatic double acting cylinder. Pneumatic Circuits: Direct and Indirect actuation of cylinders – Use of shuttle valve and quick exhaust valve - Speed control circuit (Meter – in & Meter – out).		9
Ex.No	Name of the Experiment	
5	Direct actuation of cylinders.	12
6	Operation of double acting cylinder using shuttle valve	
7	Operation of double acting cylinder using quick exhaust valve	
8	Automatic operation of double acting cylinder – single cycle using limit	

	switch and pilot valve.	
Unit V	ELECTRO-PNEUMATICS	
Control Circuit Components: Switches – Push button, selector, proximity switch, Reed switch. Electromagnetic Relays – Electronic Timer. Double Solenoid Pneumatic Valve, Electrohydraulic Servo and proportional valves. Indirect actuation of cylinders using relay – Logic control circuit for pneumatics/hydraulics (AND/OR)		9
Ex.No	Name of the Experiment	
9	Indirect actuation of cylinders using relay	6
10	Logic control circuit for pneumatic actuator (AND Logic)	

Text Book & Reference Books:

1. Majumdar S.R., Pneumatic Systems: Principles and Maintenance, Tata McGraw-Hill Education, 2005.
2. Anthony Esposito, Fluid Power with Applications, 7th edition, Pearson Education, 2013.
3. Michael J. Prinz, Hydraulics and Pneumatics: A Technician's and Engineer's Guide, 3rd edition, Butterworth-Heinemann, 2015.
4. Shanmugasundaram, K., *Hydraulic and Pneumatic Controls*, 1st Edition, Chand & Co. Ltd., 2006.

Web-based/Online Resources:

- https://nptel.ac.in/courses/112105046
- https://www.lincolncollege.edu/basics-of-hydraulics-and-pneumatics

Equipment / Facilities required for conducting the Practical Course

Sl. No	Name of Equipments	Quantity Required
Pneumatics Lab		
1.	Basic Trainer Kit	2 No's

2.	Electro Pneumatic Trainer Kit	2 No's
Hydraulic Lab		
3	Basic Trainer Kit	2 No's
4.	Electro Hydraulic Trainer Kit	1 No
Control Circuit Component		
5.	Three Phase Induction Motor – ¼ HP , 440 V, 50Hz	4 No's
6.	Single Phase water pump motor	2 No's
7.	Sensors Proximity Sensors Limit Switches Reed switch	 4 No's 8 No's 4 No's
8.	230 V / 440 V Contactor	10 No's
9.	230 V AC / 24 V DC External Timer	5 No's
10.	Push button (NO & NC Contact)	Each 10 No's

1047234320	EMBEDDED PROGRAMMING	L	T	P	C
PRACTICAL		0	0	4	2

Introduction

In the rapidly growing digital world, role of embedded systems is increasingly vital in various domains such as industrial and home automation, entertainment systems, medical equipment's and many more. The core of all such system is powered by electronic hardware and associated software. It is therefore evident to impart the knowledge of the related technology and hands on skills to develop and maintain electronics hardware based embedded systems.

Course Objectives

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency: The purpose of embedded systems is to control a specific function within a device. They are usually designed to only perform this function repeatedly, but more developed embedded systems can control entire operating systems.

Course Outcomes

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

1) Select the relevant microcontrollers for various industrial applications.
2) Use 'Embedded C' programming language to maintain embedded systems.
3) Interpret the communication standards of embedded systems.
4) Develop basic applications using embedded systems.
5) Interpret features of Real Time Operating System.

Pre-requisites

Basic of C programming and microcontrollers programming

1047234320	EMBEDDED PROGRAMMING	L	T	P	C
PRACTICAL		0	0	4	2

CO / PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	2	3	-	-	-
CO2	3	3	3	3	-	-	-
CO3	3	3	3	3	-	-	-
CO4	3	2	3	3	-	-	-
CO5	3	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.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1047234320	EMBEDDED PROGRAMMING	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 (Ex no 1 to 8)	Practical Test (Ex no 9 to 16)	Model Practical Exam.	Record of Work Done / Activity Report	Practical Examination
Duration	2hrs	2hrs	3hrs	Regularly	3 hours
Exam Marks	60	60	100	(100)	100
Converted to	15	15	15	10	60
Marks	15		15	10	60
Internal Marks	40				60

Note:

CA1 and CA2: It should be conducted as per the end semester question pattern for 60 Marks. The 60 marks awarded will be converted to 15 Marks.

The best one will be considered for the Internal Assessment of 15 Marks.

CA 3: After completion of all the exercises, model examination should be conducted as per end semester question pattern.

The marks awarded should be converted to 15 Marks for the internal assessment.

CA 4: Record of work done should be maintained and the same have to be evaluated after completion of each practical exercise before the commencement of the next exercise for 10 Marks. (And / Or) The activity report should be completed and the same should be evaluated for 10 marks.

The marks awarded should be converted to 10 Marks for the internal assessment.

1047234320	EMBEDDED PROGRAMMING	L	T	P	C
PRACTICAL		0	0	4	2

SI.NO	Name of the Experiments	Periods
	Identify the pins of 8051 and AVR microcontrollers.	3
	Identify the pins and features of PIC microcontrollers	3
	Identify the features of ARM microcontroller on the basis of IC number.	2
	Use Integrated development environment tool for developing embedded 'C' programs (Using Micro ProC / Keil).	4
1	Execute the 'C' program to perform following arithmetic operations on 8-bit data: addition, subtraction, multiplication and division.	4
2	Develop and test the C program to following arithmetic operations on 8 bit data: addition , subtraction, multiplication and division	4
3	Develop and Test the 'C' program to perform data transfer from source to destination (Use internal data memory locations).	4
4	Interface RS232 connector to PC using MAX232 IC.	4
5	Develop and test the 'C' program to turn on LED (S) with key (S) press.	4
6	Interface 89C51 / A YR microcontroller and write the 'C' program to display numbers from O to 9 on 7-segment display with specified delay.	4
7	Interface 89C5 l / A YR microcontroller and write C program to display string on given 16 x 2 LCD.	4
8	Interface 89C5l / A YR microcontroller and write 'C' language program to read key code from 4 x 4 matrix keyboard and LCD display.	4
9	Interface 89C51 I A VR microcontroller and write C program to convert analog signal into digital form using given 8 bit ADC and store the converted digital data in memory.	4
10	Interface saw tooth 89C51 and write C program to generate square and waveforms using given 8 bit DAC. 89C51 and write C program to generate square and waveforms using given 8 bit DAC.	4
11	89C51 I A VR microcontroller and write C program to rotate stepper motor with different speeds in clockwise and counter clockwise direction	4
12	Interface 89C51 and write C program to observe the real time status of the triangular waveform generated using DAC (Use any IDE tool).	4

1047234320	EMBEDDED PROGRAMMING	L	T	P	C
PRACTICAL		0	0	4	2

Allocation of Marks for CA 1 & CA 2 and CA 3 Tests

Section	Description	Marks
1	Aim & Program	40
2	Execution and result	20
TOTAL MARKS		60

Equipment's name with board specification:

1	Microcontroller kit (8051,A VR/PI C/ARM): Single board system with minimum 8K RAM,ROM memo ry with battery backup,16X4,LCD display,7-segment Display, PC keyboard interfacing facility, 4X4 matrix keyboard cross c compiler USB, interfacing facility with built in power supply
2	Arduino Board with A VR microcontroller
3	Desktop PC with Integrated Development Environment (Micro ProlKeil. Proteus).
4	Stepper Motor- 50/100 RPM (or any relevant).
5	CRO-Bandwidth A 20MH z (-3dB). DC - 20MHz (-3dB), X10 Probe.
6	ADC (0808) trainer board.
7	DAC (0808) trainer board.
8	Add on cards.
9	Digital Multi meter display, 9999 counts digital multimeter Capacitance and Temperature measurements.

<table>
<tr><td>1047234440</td><td rowspan="2">MECHANICS OF MATERIALS</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>

Introduction:

Mechanics of materials is a key subject in mechatronics engineering that focuses on how solid objects behave when they are put under various forces and pressures. It's vital it helps us understand and predict if a material can handle certain loads without breaking. Strength of materials is the discipline related to calculation of stresses and strains in structures and mechanical components. It helps engineers make informed decisions about material selection, decision and construction.

Course Objectives:

Acquire knowledge about selection of materials

1. Understand the basics of engineering materials and their role in the development of societies and industries
2. Towards developing the theoretical basics about the stress, strain and elastic modulus concepts in various components.
3. Understand the mechanical behaviour of materials.
4. To solve practical problems related to shafts and springs

Course Outcomes:

CO1: Understand the various tools that can be used to select the appropriate materials.

CO2: Determine the simple stresses and strains when members are subjected to different loading.

CO3: Design simple circular shafts.

CO4: Design closely coiled helical springs subjected to an axial load.

CO5: Select the suitable belt drives and gear drives for power transmission.

1047234440	MECHANICS OF MATERIALS	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	2		
CO2	3	2	3	1	2		
CO3	3	2	3	1	2		
CO4	3	2	3	1	2		
CO5	3	2	3	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.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancy

1047234440	MECHANICS OF MATERIALS	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	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II 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 Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents 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.

The details of the documents to be prepared as per the instruction below.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim / Apparatus required	5
B	Procedure / Observation	20
C	Formula / Calculation	20
D	Result / Graph	5
TOTAL		50
E	Practical Documents (As per the portions)	10
		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.

Question pattern – Written Test Theory

Description		Marks	
Part – A	10 Three mark Questions	10*3	30 Marks
Part – B	7 Questions to be answered out of 10	7 X 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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	10
B	Procedure / Observation	30
C	Formula / Calculation	30
D	Result / Graph	20
E	Viva Voce	10
	TOTAL	100

1047234440	MECHANICS OF MATERIALS	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion	Periods
Unit I - Introduction to Engineering Materials Ferrous and Non-Ferrous Materials-Alloying Elements and Their Effects-Definition of Mechanical Properties-Selection of Materials: Factors Affecting Selection and Procedure **Advanced Materials** Smart Materials and Nano Materials-Classification and Applications of Nano Materials	
Unit-II - Linear measuring instruments & Angular Measuring Instruments Construction and Principles Steel Rule, Combination Set, Feeler Gauge, Pitch Screw Gauge, Vernier Caliper, Digital Caliper, Vernier Height Gauge Micrometer, Inside Micrometer, Thread Micrometer, Slip Gauges: Requirements, Indian Standard, Care, and Use **Angle Measurement Instruments** Vernier Bevel Protractor, Universal Bevel Protractor, Optical Bevel Protractor Side Bar: Types, Uses, and Limitations Working Principle of Clinometer, Autocollimator, Angle Dekkor	15
Unit-III - Simple stresses and strains Definition - load, stress and strain - classification of force systems - tensile, compressive and shear force systems– Definition - Hook's law -Young's modulus - working stress, factor of safety, load factor, shear stress and shear strain - modulus of rigidity - deformation due to tension and compressive forces - simple problems in tension, compression and shear force. Lateral strain – Poisson's ratio – volumetric strain – bulk modulus – volumetric strain of rectangular and circular bars.	
UNIT-IV **Torsion** Theory of torsion - assumptions - torsion equation (no derivation)- strength of solid and hollow shafts - power transmitted - definition - polar modulus –sectional modulus - torsional rigidity - strength and stiffness of shafts - comparison of	

hollow and solid shafts in weight and strength considerations- advantages of hollow shafts over solid shafts – shear stress distribution -problems.	
UNIT-V- Springs Types of springs - laminated and coiled spring - applications - types of coiled springs - difference between open and closely coiled helical springs – closely coiled helical spring subjected to an axial load (no derivation)	
Practical Exercises 1) Measure the dimensions of ground MS flat / cylindrical bush using Vernier Caliper compare with Digital / Dial Vernier Caliper 2) Measure the diameter of a wire using micrometer and compare the result with digital micrometer 3) Measure the thickness of ground MS plates using slip gauges 4) Measure the height of gauge blocks or parallel bars using Vernier height gauge 5) Find the Young's Modulus, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel 6) Determination of Rockwell's Hardness Number for various materials like mild steel, high carbon steel, brass, copper and aluminum. 7) Find the impact strength of given specimen (mild steel & cast iron) using charpy test. 8) Find the impact strength of given specimen (mild steel & cast Iron) using Izod test 9) Determine the shear stress and modulus of rigidity of the given specimen using Torsion testing machine. 10) Tension test of spring to find modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (Open or Closed coil spring) 11) Find the velocity ratio of the given gear train. 12) To study the gear tooth profile using gear tooth Vernier. 13) To study the types of gears used in different engineering applications. 14) To study the different belts used in belt drives with its application	60

15) To study effect of friction using different types of bearings.	
Total	**75**

Text and Reference Books:

1. **R.S. Khurmi**, *Strength of Materials*, Latest Edition, S. Chand & Co., New Delhi.
2. **S. Ramamrutham**, *Strength of Materials*, 15th Edition, Dhanpat Rai Pub. Co., New Delhi, 2004.
3. **R.K. Bansal**, *Engineering Mechanics*, 5th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2017.
4. **Rajput R.K.**, *Mechanical Measurements and Instrumentation*, Latest Edition, S.K. Kataria & Sons.
5. **S.S. Rattan**, *Theory of Machines*, Latest Edition, Tata McGraw-Hill Publishers, New Delhi, 2018.

Web-based/Online Resources:

- https://onlinecourses.nptel.ac.in/noc23_me140/preview
- Virtual Labs | Mechanical Engineering (vlab.co.in)

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

S.No	Name of the Equipment's	Quantity Required
1.	Universal testing machine	1 Nos.
2.	Rockwell's hardness testing machine	1 Nos.
3.	Torsion testing machine	1 Nos.
4.	Spring testing machine	1 Nos.
5.	Impact testing machine	1 Nos.
6.	Slip Gauge set	2 Nos.
7.	Vernier Caliper	5 Nos.

8.	Micrometer	5 Nos.
9.	Vernier height gauge	5 Nos.
10.	Gear tooth Vernier	2 Nos.
12.	Gear Train	3 Nos.
13.	Consumables	Sufficient quantity

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

Industrial Drives and Control" is a fundamental aspect of modern industrial engineering, focusing on the efficient operation and regulation of machinery and processes within industrial settings. It encompasses a range of technologies and methodologies designed to drive and regulate various types of industrial equipment, such as motors, pumps, conveyors, and robotics, among others. These drives can be electrical, mechanical, hydraulic, or pneumatic, depending on the specific application and requirements of the industrial process. Electrical drives, for instance, are prevalent due to their flexibility, efficiency, and ease of control.

Course Objectives

The objective of this course is to

1. Understanding of Drive Systems
2. Analysis and Design of Control Systems for industrial applications
3. Implementation of Variable Speed Drives
4. Trouble shooting and Maintenance.
5. Case Studies and Practical Applications of industrial applications

Course Outcomes

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

CO1: Understand and implementation of Industrial Drives and Power Electronics.

CO2: Understand and practice on DC Motor Drives and

CO3: Understand and practice on Servo and Stepper Motor Drives

CO4: Understand thebasics of Industrial Applications of Drive Systems

Pre-requisites

Basic Engineering Knowledge, Electrical Engineering Fundamentals, Circuit Analysis and Mechanical Systems.

CO/PO Mapping

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	-	1	-	2	-	2
CO2	2	-	2	2	2	-	2
CO3	2	-	2	2	2	-	2
CO4	2	-	2	2	2	-	2
CO5	2	-	2	2	2	-	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 like Simulation.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where they could be the source of error, if any. Teachers shall use simulation teaching aids wherever possible.

1047234540	INDUSTRIAL DRIVES AND CONTROL	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	Practical Test	Practical Examination
Portion	Cycle I Exercises	Cycle II 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 Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Practical documents 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.

The details of the documents to be prepared as per the instruction below.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim and Apparatus Required	5
B	Circuit diagram	15
C	Connection and Procedure	10
D	Observations, Calculation/graph	15
E	Result	5
TOTAL		50
F	Practical Documents (As per the portions)	10
		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.

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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 and Apparatus Required	10
B	Circuit diagram	20
C	Connection and Procedure	30
D	Observations, Calculation/graph	20
E	Result	10
F	Viva Voce	10
	TOTAL	100

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion:	
Unit-I	**Periods**
Introduction to Industrial Drives and Power Electronics Definition and significance of industrial drives in mechatronics. Overview of various types of industrial drives: DC, AC, servo, stepper. Components and basic structure of industrial drive systems. Fundamentals of power electronics and their role in industrial drive systems. Power semiconductor devices: Introduction of diodes, thyristors(SCR), MOSFETs, IGBTs. Power converters in drive systems: Introduction and its types of Converters, inverters, choppers, cycloconverters.	15
Unit-II	
DC Motor Drives Principles of operation of DC motors: brushed and brushless. Characteristics of DC motors: speed-torque curves, efficiency, starting methods. Control techniques for DC drives: armature voltage control, field control, chopper control, four quadrant methods. **AC Motor Drives** Introduction to AC motors: induction motors, synchronous motors. Operating principles of AC motors and their differences from DC motors. Control methods for AC drives: voltage control, frequency control, vector control.	

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Unit III **Servo and Stepper Motor Drives** Overview of servo motors and their characteristics: high precision, high torque, feedback control. Control systems for servo drives: PID control, feed forward control, motion profiles. Introduction to stepper motors: types, step modes, resolution, torque-speed characteristics. Control techniques for stepper drives: open-loop control, closed-loop control, micro stepping.	
Practical Experiments-PART A	**Periods**
1. Construct a circuit with a thyristor (SCR), a DC voltage source, and a load resistor and Measure and observe the thyristor's turn-on characteristics by varying the gate trigger voltage and. 2. Build a circuit with a MOSFET or IGBT, a DC voltage source, and a resistive load and Investigate the switching behavior of the MOSFET or IGBT by applying gate signals with different rise and fall times. 3. Construct a single-phase or three-phase rectifier circuit using diodes or thyristors and Measure the output voltage and current waveforms for different load conditions and input voltages. 4. Set up a single-phase or three-phase inverter circuit using IGBTs or MOSFETs and Generate sinusoidal output voltages by modulating the switching of the power devices. 5. Build a chopper circuit using MOSFETs or IGBTs to control the speed of a DC motor and Experiment with different PWM (Pulse Width Modulation) techniques to vary the motor speed and direction. 6. Design and implement a cycloconverter circuit to convert AC power at one frequency to AC power at another frequency and Measure the output waveform and frequency under various load conditions.	60

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Practical Experiments: PART - B	
7. Speed Control of a DC Motor using PWM techniques. 8. Speed Control of an AC Induction Motor using a Variable Frequency Drive 9. Stepper Motor Control with various step modes and torque measurements. 10. Closed-Loop Position Control of a Stepper Motor using an Encoder.	
TOTAL PERIODS	**75**

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 books Reference

- Rashid M.H., Power Electronics: Circuits, Devices & Applications, 4th edition, Pearson Education, 2014.
- Dubey G.K., Fundamentals of Electrical Drives, 2nd edition, Narosa Publishing House, 2007.
- Sen P.C., Principles of Electric Machines and Power Electronics, 3rd edition, Wiley, 2013.
- Power Electronics: Converters, Applications, and Design" by Ned Mohan, Tore M. Undeland, and William P. Robbins:
- Industrial Motor Control" by Stephen L. Herman:

Web-based/Online Resources

- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-685-electric-drives-spring-2013/
- https://www.learnengineering.org/

1047234540	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

1047234640	INTRODUCTION TO IOT	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

The Internet of Things (IoT) represents a transformative evolution in technology, connecting everyday objects to the internet and enabling them to send and receive data. This course is designed to introduce the foundational concepts and practical applications of wireless networking and the Internet of Things (IoT). Through hands-on experience with the ESP8266 Wi-Fi module, students will learn to connect sensors to web services and cloud platforms, enabling the creation of smart, interconnected systems.

Course Objectives:

The objective of this course is to enable the student to

1. To Understand the Architectural Overview of IoT
2. Understand individual components of IoT systems.
3. Practice the built- in, library and user defined functions in the program
4. Understand the fundamental principles of wireless networking and the Internet of Things (IoT), with a specific focus on using the ESP8266 Wi-Fi module to connect sensors to web services and cloud platforms.
5. Recognize the need of IoT in real- world problems

Course Outcomes:

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

CO1	:	Explain the IoT Architecture
CO2	:	Apply basic programming skills to develop the code for the Arduino Uno board
CO3	:	Interface different sensors and actuators with Arduino board
CO4	:	Configure and use the ESP8266 Wi-Fi module for various networking tasks.
CO5	:	Apply various components of Io to solve a real world problem.

1047234640	INTRODUCTION TO IOT	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	-	-	1	-
CO2	3	3	3	1	-	-	-
CO3	3	1	1	1	-	1	2
CO4	2	3	2	-	2	2	2
CO5	2	-	1	2	1	2	3

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

Instructional Strategy:

- It is advised that teachers take steps boost the 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

1047234640	INTRODUCTION TO IOT	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	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises	Cycle II Exercises	All Portions	All Exercises	All Exercises Experiments
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical documents should be maintained for every 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.

The details of the documents to be prepared as per the instruction below.

Each experiment should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment.

This documentation can be carried out in a separate notebook / printed manual / file. The Program, Procedure, Sketch and Output should be written by the student manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Tools Required	10
B	Procedure / Steps	20
C	Execution	20
	TOTAL	50
D	Practical Documents (As per the portions)	10
		60

Cycle I: 1, 2, 3 4, and 5.

Cycle II: 6, 7, 8, 9 and 10.

- **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.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10	7 X 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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 & Tools Required	10
B	Procedure / Steps	20
C	Execution	20
D	Output / Result	10
E	Written Test	30
F	Viva Voce	10
	TOTAL	100

Note: For the written test 30 MCQ shall be asked from the theory portions.

1047234640	INTRODUCTION TO IOT	L	T	P	C
PRACTICUM		2	0	2	3

Theory Portion		
UNIT I:		Period
Introduction to IoT –Definition and Characteristics of IOT-IoT Architecture-Physical Design of IoT-Things in IoT, -IOT protocols – Logical design of IoT-IoT functional blocks-IoT communication models- Overview of IoT components and IoT Communication Technologies IoT Levels and Deployment templates-IoT Level1 to IoT Level 6.		7
UNIT II:		
Basics of Wireless Networking-Introduction to ESP8266 Wi-Fi Module- Various Wi-Fi library -Web server- introduction, installation, configuration - Posting sensor(s) data to web server M2M vs. IOT, IOT protocols, Cloud architecture, Cloud computing and it's Benefits, Thing Speak API and MQTT, Interfacing ESP8266 with Web services		8
Practical Exercises:		
1	To implement LED Blink and LED pattern with Arduino	5
2	Creating different LED patterns and controlling with push button switches.	5
3	Automated LED light control based on input from IR sensor and LDR	5
4	To display your name in a LCD 16 x2 display with Arduino.	5
5	Controlling servo motors with the help of joystick	5
6	Measurement of temperature and Pressure using ESP32	5
7	Calculate the distance to an object with the help of an Ultrasonic	5

	sensor and display it on a LCD	
8	Design a system that integrates ultrasonic sensors for accurate distance measurement in the identified areas.	5
9	integrate sensors such as GPS, accelerometers, and panic Basic Burglar alert security system with the help of PIR sensor and Buzzer	5
10	Modules and sensor interfacing - Interfacing IR sensor and LED with ESP32	5
Revision + Continuous Assessment		10
Total Period		75

Suggested List of Students Activity:

1. Each students to write and submit the assignment on the topic 'Contrast IT and OT'
2. Four students can be grouped as a batch and practice an additional experiment to interface any one of the Arduino compatible sensors with Arduino and observe the behaviour of sensors.
3. Introduction to Arduino platform and programming
4. Study on various sensors and actuators.

Text and Reference Books:

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IoT, First Edition, Cambridge University Press, 2022.
2. Alasdair Gil Christ, Industry 4.0: The Industrial Internet of Things, Apress, Publications, 2016.
3. Sudan Jha, Usman Tariq, Gyanendra Prasad Joshi, Vijender Kumar Solanki, Industrial Internet of Things: Technologies, Design, and Applications, CRC Press, 2022.

Web-based/Online Resources:

1047234640	INTRODUCTION TO IOT	L	T	P	C
PRACTICUM		2	0	2	3

https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Equipment / Facilities required to conduct the Practical Course.

S.No	Name of the Equipment's	Quantity Required
1.	Arduino UNO set	15
2.	ESP32 set -Type C	15
3.	LED Bulb	15
4.	Resistor	15
5.	Push button	15
6.	Servo motor 5V DC	15
7	DC motor	15
8	5V DC Relay	15
9	Mini Breadboard	15
10	16 X 2 LCD Display with TTL	15
11	Gas sensor MQ2	15
12	IR Sensor	15
13	Temperature sensor DHT11 module	15
14	Ultrasonic sensor HC-SR04	15
15	Joystick module	15
16	Jumper wires - 3 nos.	As Required

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

Note:

All the exercises/experiments should be completed before the Board Practical Examinations. End Semester Practical examination should be conducted for all the exercises / experiments for 100 Marks. Students will be permitted to select any one exercise by lot or question paper supplied by the DOTE Exam section shall be used. The practical document prepared by the student should be submitted with a Bonafide Certificate.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Tools Required	10
B	Procedure / Steps	20
C	Execution	20
D	Output / Result	10
E	Written Test	30
F	Viva Voce	10
	TOTAL	100

Note: For the written test 30 MCQ shall be asked from the theory portions.

Regulation2023

Program Structure

Diploma in Mechatronics

V SEM SYLLABUS

1047235110	Robotics	L	T	P	C
Theory		**3**	**0**	**0**	**3**

Introduction:

This subject covers the fundamentals of robotic technology in a very comprehensive manner. The subject emphasizes on robot programming and languages, and covers concepts of sensors and machine vision system. Industrial and manufacturing applications using robotic technology evolved so far is discussed in detail. If the student is aiming for higher studies, this subject is the foundation.

Course Objectives:

Understand and discuss the fundamental elementary concepts of Robotics.

- Provide insight into structure and elements of robot.
- Gain knowledge on controller, gripper, and various drives used in robotics
- Develop knowledge on role of sensors and vision system
- Acquire skill to program and control robot
- Understand to adopt robot to various industrial applications.

Course Outcomes:

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

1. Discuss the basic configuration components and parts of a robot.
2. Use the suitable controller, drives system and end-effectors for a given robotics application.
3. Describe the working principles of various sensors and functions of vision machine system.
4. Discuss the concepts of Robot Kinematics and Programming.
5. Analyze the applications of Robot in various Industrial Application.

CO PO Mapping:

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

CO5	3	2	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.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60

1047235110	Robotics	L	T	P	C
Theory		**3**	**0**	**0**	**3**

Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline. The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 15 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

1047235110	Robotics	L	T	P	C
Theory		**3**	**0**	**0**	**3**

UNIT–I FUNDAMENTALS OF ROBOT TECHNOLOGY	
History of Robot - Introduction – History of robot – Definitions - Robot Anatomy – Basic configuration of Robotics – Robot Components – Manipulator, End Effecter, Drive system, Controller and Sensors. Robot arm - Mechanical arm – Degrees of freedom – Links and joints – Types of joints – Joint notation scheme –Degrees of freedom associated with arm and body - Degrees of freedom associated with wrist Classification of robots- Cartesian, Cylindrical, spherical, horizontal articulated (SCARA) vertical articulated – Work envelope, Work volume – Introduction to PUMA Robot.	9
UNIT–IIROBOT CONTROLLER, DRIVE SYSTEMS AND END EFFECTER	
2.1 Robot controller – Configuration - Four types of controls – Open loop and closed loop controls – servo systems- Precision of movements: Spatial resolutions, accuracy and repeatability 2.2 Drive system -Pneumatic drives – Hydraulic drives – Electrical drives – Stepper motors, Servo motors – Salient features – Applications and Comparisons of Drives. 2.3 Feedback Devices- Potentiometers - Optical encoders - Resolvers 2.4 End effecters – Grippers – Mechanical Grippers, Magnetic Grippers, Vacuum Grippers, Adhesive Grippers – Gripper selection and design consideration.	9
UNIT–III SENSORS AND MACHINE VISION	
3.1 Sensors - Requirements of Sensors – Sensor used in robot work cell - Principles and applications of the following types of sensors - Piezo - Electric sensors – Range sensors – Proximity sensors: Inductive, Capacitive, and Optical – Tactile sensors. 3.2 Machine Vision System –Sensing and digitizing image data – Signal conversion – Image storage – Lighting techniques – Image processing and analysis – Data reduction- Segmentation: Thresholding, Region Growing Edge detection- Feature extraction and object recognition – Applications – Inspection.	9

1047235110	Robotics	L	T	P	C
Theory		**3**	**0**	**0**	**3**

UNIT–IV ROBOT KINEMATICS AND ROBOT PROGRAMMING	
4.1 Robot Motion Analysis- Forward kinematics and Reverse kinematics of manipulators with Two and Three degrees of freedom – Robot dynamics (Only introduction) 4.2 Robot programming – On-Line & Off-Line programming - Lead through methods: Powered Lead through method and manual lead through Method- textual robot languages 4.3 Robot programming Aids -Teach pendant 4.4 Robot languages –The Textual Robot Languages - Generation of robot programming languages – Basic Robot commands – Motion Commands, Speed Command, Sensor Commands, End Effector Commands, WAIT & DELAY Commands.	9
UNIT–V ROBOT APPLICATIONS IN MANUFACTURING	
5.1 Industrial Applications of Robots – Material handling Applications: Material transfer – Palletizing and De palletizing, Machine tool loading and unloading – Spot welding – Arc welding – Spray painting – Automatic Guided Vehicle 5.2 Adopting robots to workstations - Robot cell layouts – Requisite robot characteristics and Non requisite robot characteristics – Stages in selecting robots for industrial applications – Safety considerations for robot operations 5.3 Economic analysis of robots –– Methods of economic analysis : Pay back method , Equivalent uniform annual cost method (EUAC), Return on investment(ROI) method	9

Suggested List of Students Activity:

Lectures with discussions, question and answer sessions, informal quizzes, video sessions where students have an opportunity to clear concepts and doubts. E – Resources and E-Learning for the virtual learning environment to prepare the students ready for each and every circumstance. Presentation / Seminars by students on any recent technological developments based on the course.

1047235110	Robotics	L	T	P	C
Theory		**3**	**0**	**0**	**3**

Text Books:

1. A.K Gupta, S.K. Arora, Industrial Automation and Robotics, Laxmi Publications (P) Ltd, 2013.
2. Mikell P. Groover, *Industrial Robotics: Technology, Programming, and Applications*, 2nd Edition, McGraw-Hill Education, 2020.
3. S.R. Deb, S. Deb, *Robotics Technology and Flexible Automation*, 2nd Edition, Tata McGraw-Hill Education, 2017.

Web-based/Online Resources:

1. https://www.brainkart.com/article/Fundamentals-of-Robot_5118/
2. https://www.assemblymag.com/ext/resources/White_Papers/Sep16/Introduction-to-Machine-Vision.pdf\
3. https://otssolutions.com/role-of-ai-in-manufacturing-industry//

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

Introduction:

Control systems are integral to modern industrial processes, ensuring precision, efficiency, and safety. This course is designed to provide students with a thorough understanding of control systems, from fundamental concepts to complex implementations, using both theoretical knowledge and practical applications. It provides the foundational knowledge and practical skills necessary to excel in fields such as industrial automation, process engineering, and instrumentation

Course Objectives:

The objective of this course is to enable the student to

- Understand and explain the fundamental concepts of control systems
- Interpret Piping and Instrumentation Diagrams (P&ID) according to BIS standards.
- Describe and differentiate between cascade control, ratio control, and feed forward control systems.
- Understand the basics of DCS and SCADA and the block diagram of a fuzzy logic controller with practical applications like washing machines.
- Understand and Analyse PID Controllers
- Understand and apply the principles of final control elements

Course Outcomes:

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

CO1 : Discuss basic terminologies, need, application and representation of closed loop control systems in process industries.

CO2 : Study the architecture of distributed and complex control system.

CO3 : Analyse the characteristics and principles of on-off and PID controllers.

CO4 : Evaluate the gain of the controller by appropriate method of tuning.

CO5 : Examine the characteristics and types of finite control elements.

Pre-requisites: Basic science and Mathematics

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

CO/PO Mapping

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

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test Theory (Any Two Units)	Written Test Theory (Another Two Units)	Practical Test (All Exercises)	Written Test (Complete Theory Portions)	Written Examination (Complete Theory Portions)
Duration	2	2	3	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	6th Week	12th Week	15th Week	16th Week	

- **CA1 and CA2:** Assessment written test should be conducted for 50 Marks. The marks scored will be converted to 10 Marks for each test. Best of one will be considered for the internal assessment of 10 Marks.

  CA1 and CA2, Assessment written test should be conducted for two units as below.

  PART A: (5 X 10 Marks = 50 Marks).

  Eight questions will be asked, students should write Five questions.

  Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

- **CA 3:** 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 practical test should be conducted as per the scheme of evaluation as below. The marks awarded will be converted to 15 Marks for the internal mark.

  Practical documents should be maintained for every exercise / experiment immediately after completion of the practice. The practical document should be submitted for the practical test. Each exercise/experiment should be evaluated for 10 Marks. The total marks awarded should be converted to 30 Marks for the practical test as per the scheme of evaluation as below.

  The details of the documents to be prepared as per the instruction below.

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim & Apparatus Required	5
B	Circuit Diagram	20
C	Connections	20
D	Observations, Calculation/graph	20
E	Results	5
E	Practical document (All Practicals)	30
F	Viva Voce	10
Total		100

CA4: Model examination should be conducted for complete theory portions as per the end semester question pattern. The marks awarded should be converted to 15 marks for the internal assessment.

Question Pattern:

Answer ten questions by selecting two questions from each unit. Each question carries 10 marks each.

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Question Pattern - Model Examination and End Semester Examination - Theory Exam

PART- A (5 X 20 Marks = 100 Marks)

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

Theory Portion:	
UNIT-I	Period
Definition – Process – Functional block diagram of an Automatic process control system – Set point – Measured variable – Comparator – Error – Controller – Final control element. Controlled variable – Manipulated variable – disturbances – Advantages of Automatic control system – Simple Liquid level control system – Temperature control system with transportation Lag – Self Regulation – Capacitance and Capacity. Piping and Instrumentation flow Diagram (BIS standard) for the above system.	9
UNIT-II	
COMPLEX CONTROL SYSTEMS Cascade control system, Ratio control systems, feed forward control system, Comparison of feedback control system and feed forward control system, Multivariable Control System, Selective Control System, Adaptive Control System, Split Control System(One specific application for each of the above systems) – Block Diagram of Fuzzy logic controller – typical application-washing machine	9
Unit-III Controllers	
Controller – Block diagram, Types, General properties – Reverse and Direct action, Controller modes – Discontinuous – On – Off Control with differential gap, without differential gap – Neutral zone– Continuous – Proportional controller – Proportional band (PB) – Effect of PB on a controller output – Offset –Integral control – PI – PD – PID – Definition, salient features, applications and limitations of the above controllers – Selection of control action – Electronic controllers	8
Unit-IV FINAL CONTROL ELEMENTS	**Period**

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

Principle of Flapper Nozzle and Pneumatic controller Signal converters – P to I Converter, I to P Converter Actuators – Electrical, Pneumatic, Hydraulic and Electro pneumatic Control valve –Construction and Characteristics-Quick opening, Linear, Equal percentage Case Study: Select a control valve and size it for a particular application	9
Unit-V DISTRIBUTED CONTROL SYSTEM	
Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. Alarms, interrupts. Characteristics of digital data, controller software, linearization Distributed Control System Basics: DCS introduction, Various function Blocks, DCS components/block diagram, DCS Architecture of different makes, comparison of these architectures with automation pyramid, DCS specification, latest trend and developments, DCS support to Enterprise Resources Planning (ERP), performance criteria for DCS.	9
Practical Exercises:	

Ex.No	Name of the Experiment	Period
1.	Measurement of temperature using RTD/ Thermistor /Thermocouple	30
2.	On- off control of temperature process, pressure process, level process	
3.	Simulation of ratio control system	
4.	Case Study-Reading of P&I Diagram of an Industry	

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

5.	Analyse the effect of Proportional, Integral and Differential Gain by Simulating a First order system in Matlab/ open source platform.	
6.	Conduct an experiment to analyse the response of PID Controller	
7.	Conduct experiment to observe response of PD controller in a Liquid Level process	
8	Experimentally obtain the characteristics of P to I converter	
9	Experimentally obtain the Characteristics of control valve	
TOTAL PERIODS		**75**

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. S. K. Singh, Industrial Instrumentation and Control, 3rd Edition, Tata McGraw-Hill Education, 2009.
2. D. Patranabis, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw-Hill Education, 2011.
3. Rangan, Sharma, and Mani, *Instrumentation Devices and Systems*, 2nd Edition, Tata McGraw-Hill Education, 2009.
4. “Krishnaswamy K” “Process Control”, 2nd Edition, New Age International Pvt.Ltd.Publishers, New Delhi, 2013.
5. “ Donald P Eckman” “ Process control”,Wiely Eastern limited,1991

Web-based/Online Resources:

1. https://nptel.ac.in/courses/103103037
2. https://archive.nptel.ac.in/courses/103/105/103105064/

1047235230	CONTROL SYSTEM FOR MECHATRONICS	L	T	P	C
PRACTICUM		3	0	2	4

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

S.No	Name of the Equipment's	Quantity Required
1.	ON-OFF LEVEL PROCESS	1 No
2.	ON-OFF PRESSURE PROCESS	1 No
3.	RTD/THERMISTOR/THERMOCOUPLE TRAINER MODULE	1 No
4.	PID CONTROLLER KIT	1 No
5.	MOTORISED CONTROL VALVE SETUP WITH ACCESSORIES	1 No
6.	P TO I CONVERTER KIT	1 No
7.	PID CONTROLLER KIT TO CONTROL LEVEL	1No
8.	SYSTEM WITH APPROPRIATE SOFTWARE	1 No

1047235320	Robotics	L	T	P	C
Practical		0	0	4	2

Introduction

To provide students with a solidunderstanding to operate the robot with teach pendant and programming. They should be able to apply the programming concepts in various industrial applications.

Course Objectives

The objective of this course is to

- Analyze the different axis movement.
- Operate and control robot through teach pendant
- Operate and control robot through programming.
- Write Programs for various industrial applications.
- Understand the basic commands of robot.
- Understand the fundamentals of machine vision system in robotics.

Course Outcomes

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

CO1: Apply the knowledge of functioning and characteristics of various links and joints in industrial projects

CO2: Select a suitable gripper for various industrial applications.

CO3: Apply the knowledge of Robot programming in various industrial applications.

CO4: Demonstrate programs using wait and speed commands.

CO5: Ability to apply Programming and vision system in robot application.

Pre-requisites

Basic knowledge on science and programming

CO/PO Mapping

1047235320	Robotics	L	T	P	C
Practical		**0**	**0**	**4**	**2**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	2	-	-	2
CO2	3	2	1	2	-	2	2
CO3	3	2	1	2	-	-	2
CO4	3	2	1	2	-	-	2
CO5	3	2	2	2	-	2	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 demonstration sand plan interactive student activities for an engaging learning experience.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

Assessment Methodology

1047235320	Robotics	L	T	P	C
Practical		0	0	4	2

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle (1-7 Exp)	Second Cycle (8-15 Exp)	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	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.

1047235320	Robotics	L	T	P	C
Practical		0	0	4	2

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim& Program	10
B	Circuit Diagram	20
C	Execution and result	20
TOTAL		50

- **CA 3:** Practical document 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 and End Semester Examination with a bonafide certificate

  The details of the documents to be prepared as per the instruction below.

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation as 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	10
B	Program	30
C	Circuit Diagram	30
D	Execution and result	20
E	Viva Voce	10

1047235320	Robotics	L	T	P	C
Practical		0	0	4	2

TOTAL	100

Note:

Submission of Practical Log/ Observation book for the model practical exam is mandatory.

LIST OF EQUIPMENTS

1. Desktop Computers – 12 Users
2. Robot Simulation Software – 12 Users

3.6 Axis Articulated Robot

a. Material Handling - 1 No

2. Conveyor System - 1 No
3. Assembly Work bench with fixture
4. A mounted vision system with software (Free open source Robot simulation software)

1047235440	CIM and CNC PROGRAMMING	L	T	P	C
Practicum		1	0	4	3

Introduction:

As per the latest requirements in industries, this course enables the use of computers in the fields of design and manufacturing. It's able to learn the latest manufacturing concepts for shop floors and manufacturing methods like additive manufacturing. They are able to operate CNC machines and write CNC part programs. Enables to understand the advanced concepts adopted in automated industries and CNC machine maintenance.

Course Objective:

The student will learn

- The concept and requirements of the integration of design, manufacturing, and business activities.
- The concept and requirements of the integration of design, manufacturing, and business activities.
- The concepts of manufacturing with computer assistance in process planning, production planning, and production control.
- The principles, components, and workings of the various CNC machines.
- The principles of the latest manufacturing and metrology machines like additive manufacturing, EDM, and CMM.
- The method of CNC programming with standard G codes and M codes.
- To understand the advanced material handling and manufacturing systems like AGV, ASRS and FMS.
- To schedule maintenance on CNC machines.

Course outcomes:

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

CO1	Demonstrate the CAD modeling and activities in product design.
CO2	Apply computer-aided techniques to replace conventional manufacturing planning and control functions.
CO3	Create a CNC part program to produce components on a CNC machine.
CO4	Illustrate the effective usage of CNC in advanced machines.
CO4	Describe the integrated manufacturing system and scheduled maintenance to optimize the performance.

Pre-requisites:

Knowledge of engineering drawing, production technology, computer applications, machine element design, and electrical devices and controls.

1047235440	CIM and CNC PROGRAMMING	L	T	P	C
Practicum		1	0	4	3

Mapping of COs with POs:

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

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

Instructional Strategy:

- Different methods of teaching and demonstration to be used to attain the outcomes.
- Teacher-directed lecture class room processes with the aid of PowerPoint presentations could be used for theory.
- Video and Group Discussion may be used to teach various topics/ sub topics so that students are able to understand and grasp the concepts.
- Hand-on practices may be followed in the real environment as far as possible throughout the course.
- 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.

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Experiments	Cycle II Experiments	All Units	All Experiments	All Experiments
Duration	2 hours	2 hours	3 hours	3 hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical documents should be maintained for every 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.

  The details of the documents to be prepared as per the instruction below.

  Each experiment should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment.

  This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The student should draw the part drawing on the graph, write the CNC program, and note the dimensions of the part for all CNC exercises. The student should write the procedure and take the print out of 3D model for CAD exercises.

  The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	Description	Marks
	CAD	
A	Solid Modeling	25
B	Sectional View and Dimensioning / Slicing the model and generating the NC code	15
C	Print out	10
D	Practical Documents (As per the portions)	10
Total Marks		60

Cycle I: 1, 2, 3, 4 and 5.

1047235440	CIM and CNC PROGRAMMING	L	T	P	C
Practicum		1	0	4	3

SCHEME OF EVALUATION

Part	Description	Marks
	CNC Programming	
A	Create the CNC part program / part and setup the parameters on CAD/CAM software	25
B	Produce component / Generate the toolpath	15
C	Finishing / Print out	10
D	Practical Documents (As per the portions)	10
	Total Marks	60

Cycle II: 6, 7, 8, 9 and 10.

- **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.

Question pattern – Written Test Theory

Part	Description	Marks	
A	30 MCQ Questions	30x1 Marks	30 Marks
B	7 Questions to be answered out of 10 Questions	7x10 Marks	70 Marks
	Total Marks		100 Marks

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation. After completion of all the exercises the practical test should be conducted as per end semester examination question pattern scheme of evaluation. 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
	Solid Modeling & 3D Printing (or) **CNC Programming**	
A	Solid Modeling (or)	35
	Create the CNC part program / part and setup the parameters on CAD/CAM software (or)	
B	Sectional View and Dimensioning / Slicing the model and generating the NC code (or)	15
	Produce component / Generate the toolpath	

C	Print out (or) Finishing	10
D	Written Test (Theory Portions)	30
E	Viva Voce	10
	Total Marks	100

SYLLABUS CONTENTS:

Unit I	**COMPUTER AIDED DESIGN**	**Period**
THEORY: **CAD: (definition and concepts)** CIM wheel, CAD definition, Shigley's design process – CAD activities – benefits of CAD - Graphics Workstation Geometric modeling techniques: Wire frame – Surface – Solid modeling. **Finite element methods: (concepts only)** Finite Element Analysis PRACTICAL:		3
Ex.No.	Name of the Experiment	
1	CAD: 3D Modeling of a Plummer Block Bearing	12
2	CAD: 3D Modeling of a Screw Jack	
Unit II	**COMPUTER AIDED MANUFACTURING**	**Period**
THEORY: **CAM (definition and concepts):** Functions of CAM – Benefits of CAM – Group Technology (concept only) – CAPP: Generative type (one method only) – Master Production Schedule (MPS) – Capacity planning – Materials Requirement Planning (MRP) – Shop Floor Control - Manufacturing Resources Planning (MRP-II) – JIT – guide lines of DFMA. **Additive Manufacturing (concepts)**: Technologies: FDM, SLA and SLS.		3

PRACTICAL:		
Ex.No.	Name of the Experiment	
3	CAD: 3D Modelling of Geneva Wheel, generating STL and NC codes.	18
4	CAD: 3D Modelling of Bushed Bearing, generating STL and NC codes.	
5	CAD: 3D Modelling of Connecting Rod, generating STL and NC codes.	
Unit III	**NC MACHINES AND PART PROGRAMMING**	**Period**
THEORY: **NC Machines (concepts):** Components of NC systems - working principle – machine axis conventions - adaptive control systems - DNC - CNC. **NC part programming:** CNC program procedure – coordinate system – types of motion control: point-to-point, paraxial and contouring - NC dimensioning – reference points – G codes - M codes – machine zero, work zero, tool zero and tool offsets. Tool information – speed – feed – macro – subroutines –		3

canned cycles - **(concepts only)** Generating CNC codes from CAD models and post processing. **PRACTICAL:**		
Ex.No.	Name of the Experiment	
6	CNC Lathe: Create a part program for Step, Taper and Radius Turning using Canned Cycles and produce the part on CNC machine.	12
7	CNC Lathe: Create a part program for Grooving and Thread Cutting using Canned Cycles and produce the part on CNC machine.	
Unit IV	**CNC MACHINES AND COMPONENTS**	**Period**
THEORY: **CNC Machines (definition and concepts):** HTC, VMC, CNC EDM and CMM. **Components (definition and concepts):** Spindle drive: stepping motors – servo motors – slide ways –linear motion bearings – recirculation ball screw – ATC – tool magazine - feedback devices: encoders – linear and rotary transducers – in process probing. **PRACTICAL:**		3
Ex. No	Name of the Experiment	
8	CNC Mill: Create a part program for Drilling, Tapping and Counter Sinking using Canned Cycles and produce the part on CNC machine	18
9	CNC Mill: Create a part program for Pattern Grooving using Subroutine/ Subprogram and produce the part on CNC machine	
10	CNC Mill: Create a part using CAM software, generate the tool path and CNC program for a milling process and take the printout.	
Unit V	**INTEGRATED MATERIAL HANDLING SYSTEM AND CNC MAINTENANCE**	**Period**
THEORY: **AGV (definition and concepts):** Working principle – types - benefits – ASRS **FMS (definition and concepts):** FMS components – FMS layouts **CNC Maintenance (definition and concepts):** Preventive Maintenance – Maintenance schedule (Daily, Monthly, Quarterly, Half yearly and Annually)		3
	Revision + Test + Practice	15
	Total	**75**

Suggested activity:

Apart from classroom and laboratory learning, teachers could use the following strategies to achieve the various outcomes of the course.

- Micro-projects/ additional exercises may be given to individual/ group of students to encourage self-learning, creativity and innovation.

1047235440	CIM and CNC PROGRAMMING	L	T	P	C
Practicum		1	0	4	3

- Online MCQ have to be conducted for all the five units.

List of equipments required:

No.	Name of the Equipment / Machinery	No. of Quantity
1	Personal computer (Pentium processor)	30
2	MS Windows OS (Version 2000 or above)	30
3	AutoCAD/ Autodesk Fusion/ CREO/ FreeCAD/ SOLIDWORKS software	Sufficient Quantity
4	CNC Simulation Software / CADCAM Software	Sufficient Quantity
5	CNC Machining Centre & Turning Centre	Each 1 No
6	3D Printing software (CURA)	Sufficient Quantity
7	Laser jet printer	1

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

Various control operations are to be performed automatically and sequentially on the electrical machines to suit the industrial requirements. Programmable controllers are mainly employed to control the process in industries. In order to impart knowledge on programmable Logic Controller this theory subject is introduced.

Course Objectives

On successful completion of the course, the students must be able to

- Explain the meaning of automation and List the types of automation
- Define PLC and Explain why their use is valuable
- Explain what PLC can do
- Compare fixed and modular PLC
- Explain the advantages of PLC
- Explain the functions of various elements of power supply unit
- Know the difference between digital and analog input and output signals.
- Observe how digital field device information gets into a PLC
- Observe how analog field device information gets into a PLC
- Understand I/O addresses and how they are used in a PLC
- Describe PLC timer instruction and differentiate between a non-retentive and retentive timer
- Program the control of outputs using the timer instruction
- List and describe the functions of PLC counter instructions
- Create PLC programs involving program control instructions, math instructions

Course Outcomes

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

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

CO1: Explain the role of automation in modern manufacturing and production processes.

CO2: Demonstrate a thorough understanding of the fundamental principles of hydraulics and pneumatics.

CO3: Design basic to complex hydraulic and pneumatic circuits, demonstrating an understanding of system requirements and constraints.

CO4: Analyze and interpret fluid power schematics and diagrams to troubleshoot and optimize system performance.

CO5: Implement various control methods for fluid power systems, including manual, electrical, and electronic controls.

Pre-requisites

Knowledge about the electrical control circuits

CO/PO Mapping

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

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

Instructional Strategy

- Massive open online courses (MOOCs) may be used to teach various topics.
- The topics that are relatively simpler or descriptive are to be given to the students for **self-directed learning** and assess the outcomes through classroom seminars or group discussions.

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

- Teachers must ensure to create opportunities for co-curricular activities.
- Videos and simulations may be used to teach various topics.
- Encourage students to refer to different textbooks and case studies to have deeper understanding of the subject.
- Observe and continuously monitor the performance of the student in the laboratory.
- Instruct students about safety concerns of fluid power systems and avoid any damage to the components.

Course type 40 - Practicum - End Semester Practical Exam

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises 50% Exercises	Cycle II 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 Marks	10	10	15	15	60

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

  Practical documents 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.

The details of the documents to be prepared as per the instruction below.

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Drawing Connection/Ladder Diagram and Writing	20
B	Making the correct circuit connections	10
C	Procedure	10
D	Result	10
TOTAL		50
E	Practical Documents (As per the portions)	10
		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.

Question pattern – Written Test Theory

Description		Marks	
Part – A	10 Three mark questions	10*3	30
Part – B	7 Ten marks Question out of 10	7*10	70
TOTAL			100 Marks

- **CA 4:** 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End

Semester Examination question pattern scheme of evaluation. 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	Drawing Connection/Ladder Diagram and Writing Details of the Components/Equipments/Machines used	30
B	Making the correct circuit connections	20
C	Conducting the Experiment - Following the correct procedure - Verifying the operation / appropriate readings - Following the appropriate safety procedure	20
D	Interpretation of Results Graphical Representation (If required)	20
E	Viva Voce	10
	TOTAL	100

Suggested Student Activity:

- In addition to classroom and laboratory learning, **student-centric co-curricular activities** can be undertaken to accelerate the attainment of various outcomes of the course.
- Identify the industrial standards followed in PLC.
- Read the safety precautions to be followed for the installation of plc panel.
- Prepare a presentation or report on troubleshooting techniques.

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

Unit I	BASICS OF PLC	
Definition - Overview of PLC system - Architecture of a PLC: Function of each blocks -Types of PLC - PLC modules: Discrete and Analog I/O modules - PLC advantage & disadvantage - PLC versus Computers - PLC Applications - Scan cycle - Selection criteria for PLC – PLC Communication with PC and software- PLC Wiring- Installation of PLC and its Modules		3
UNIT II	PLC PROGRAMMING	
Fundamentals of logic – General PLC programming procedure - PLC programming methodologies: Ladder Diagram, Functional block diagram, Sequential function chart, Structured text, Instruction list – Bit Instructions – Instruction Addressing – PLC basic functions: Logical functions - Timers and counters.		3
UNIT III	ADVANCED INSTRUCTIONS	
Arithmetic functions (ADD, SUB, MUL, DIV, NEGATE)– Comparison functions (Equal, Not equal, Less Than, Greater than, Limit test) – Data transfer instructions (8-bit data, 16-bit word, Array) – Program control functions (Jump to label, Jump to subroutine, Return, Return from subroutine and Master control functions) – PID function - PTO / PWM generation.		3
Unit IV	ANALOG PROGRAMMING	
Types of analog modules – Configure analog signals in PLC – Analog Inputs: Voltage inputs, Current inputs, Analog input scaling – Analog outputs: Voltage outputs, Current outputs, Analog output scaling/un scaling - Servo drive control – Stepper Motor Control – Design of interlocks and alarms -		3
Unit V	HMI SYSTEMS	
Need for HMI in Industrial Automation - Types of HMI – Configuration of HMI – Procedure for project development - Configuration of HMI elements / objects(Defining Tags, planning graphic design, Navigation, Linking objects with tags, Tag logging) – Push buttons, Text boxes, Bar graphs, Graphics & other features – Alarm generation, Data logging, Trends generation		3

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

Ex.No	Name of the Experiment	
1	Start/Stop operation (Latching & Unlatching) of a motor using two push button	60
2	Delayed operation of a lamp using push button (On-delay & Off-delay)	
3	Event count operation using UP counter & DOWN counter	
4	Star Delta control with interlocking	
5	Tank level control.	
6	Automatic operation two pneumatic cylinders in a sequence.	
7	Illumination control using analog I/O.	
8	Heater control with PID function of the PLC	
9	Fire alarm and display the status using Multiple alarms in HMI	
10	Fire alarm and display the status using Sound alarm in HMI	
11	Fire alarm and display the status if not acknowledged, Sound alarms 1 and 2 in HMI	
12	Develop Ladder logic for Servo motor control (PLC and HMI)	

TEXT BOOKS:

1. W. Bolton ―Programmable logic controllers‖, Elsevier Ltd, 2015.
2. Frank D Petruzella, ―Programmable logic controllers‖, McGraw-Hill, 2011.

REFERENCES:

1. John R Hackworth and Fredrick D Hackworth Jr., ―Programmable Logic Controllers: Programming Methods and Applications‖, Pearson Education, 2006.
2. SIMATIC Programming with STEP 7, SIEMENS Manual, 2014.

1047235340	PLC AND HMI	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required for conducting the Practical Course

S No	Name of the Equipment	No of Quantity
1	PLC Simulation Panel any brand with software	5
2	2 Channel Analog Input and Output Module	2
3	HMI Simulation Panel any brand	5
4	Limit switch	5
5	Reed switch	5
6	Inductive proximity sensor	5
7	Capacitive proximity sensor	5
8	Solenoid valve	2
9	Double acting Cylinder	2
10	Heater Control Trainer kit	1
11	Liquid Level Control Kit	1
12	Fire alarm Control Kit	1
13	PC or Laptop	10

1040235544	PCB Design & Assembly	L	T	P	C
Practicum		1	0	4	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. Using a PCB has many advantages such as compact design, ease of testing and repair, low noise and interference, and improved reliability. Apart from electrically connecting, it also gives mechanical support to the electricalcomponents. 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. Large number of PCBs can be fabricated at the same time afterthe layout is designed once. With consumers pushing for slimmer and faster devices, and with industries seeking improved functionality, the PCB will continue to develop in the future.

Course Objectives

The objective of this course is to enable the student to

- Understand the types of PCB and component data sheet.
- Know how to draw circuit schematics using EDA tools.
- Understand PCB layout and routing.
- Understand flow chart for PCB assembly process and importance ofRoHS.
- Practice schematic PCB layout and transfer to copper clad board.

Course Outcomes

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

CO1: Identify different types of Printed Circuit Boards (PCB), list the differences between them and their adequacy for specific application. List out the menu driven items (icons) which are used for designing PCB (for any one of Electronic Design Automation tool).

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 & verify using design rule check. Identify the problems while designing the PCB and troubleshoot them. 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.
Knowledge of Analog and Digital Electronics

CO/PO Mapping

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

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Experiments/ 50% Experiments	Cycle II Experiments/ Another 50% Experiments	All Units	All Experiments	All Experiments
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
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. The best one out of two will be considered for the internal assessment of 10 Marks.

Practical documents should be maintained for every 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.

The details of the documents to be prepared as per the instruction below

- The experiment should be completed on the day of practice.
- The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment.
- This documentation can be carried out in a separate notebook / printedmanual / file. The Circuit Diagram, Readings, Calculations and Graph/Result should be written by the student manually.
- The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squadand DOTE Official.

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim	5
B	Program	20
C	Execution & Output	25
D	Practical document (All Practicals)	10
TOTAL 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.

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks

CA 4: 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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	5
B	Program	20
C	Execution	25
D	Output / Result	10
E	Written Test	30
F	Viva Voce	10
TOTAL MARKS		**100**

Note: For the written test 30 MCQ shall be asked from the theory portions.

Unit I	Introduction to PCB Design	
Basics of electronic components and circuits-Introduction to PCB design -Types -Single layer - Double layer –Multi layer - Applications-Overviewof 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)		3
Ex.No	Name of the Experiment	
	Familiarization of any Electronic design automation (EDA) software	6
1	Solder an analog circuit (Half wave rectifier) in a PCB with plated holes	
2	Solder the given common emitter amplifier circuit in a PCB with plated holes	
Unit II	Introduction to schematic design	
Drawing circuit schematics using EDA (Electronic Design Automation) tools - Net-list generation and Connectivity verification - UnderstandingPCB 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.		3
Ex.No	Name of the Experiment	
3	Create a schematic, generate net list and simulate an RC coupled amplifier	9
4	Create a schematic, generate net list and simulate a High pass filter.	
5	Create a schematic, generate net list and simulate basic logic gates (AND, OR, NOT) using discrete components.	
Unit III	PCB Design	
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.		3

Ex.No	Name of the Experiment	
6	Place the components of RC coupled amplifier and route the connections between the components manually and verify using design rule check	15
7	Place the components of RC coupled amplifier and route the connections between the components using auto routingoption	
8	Design a PCB layout for Astable Multivibrator circuit and verify using design rule check	
9	Design a PCB layout for regulated power supply, verify using design rule check and generate Gerber file, BOM.	
10	Design a PCB layout for a light dependent resistor (LDR) based automatic light switch and verify using design rule check.	
UNIT IV	**PCB Assembly**	
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-Overview.		3
Ex.No	Name of the Experiment	
11	Create symbols and foot print for IN4007diode, IC741.	9
12	Create symbols and footprint for BC107transistor, connector.	
13	Design a double-layer PCB for a simple DC motor driver circuitwith variable speed control.	
Unit V	**Manual PCB Fabrication**	
Schematic-PCB Layout-Transfer to copper clad board-Etching-Drilling-component placement-testing-Finishing.		3
Ex.No	Name of the Experiment	
14	Fabricate a low pass filter circuit manually.	6
15	Fabricate and test a power supply circuit using copper clad sheet	
REVISION		15
TOTAL HOURS		**75**

Suggested Activity

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

Textbook

1. R.S. Khandpur, Printed Circuit Boards: Design – Fabrication, 1st edition, McGraw Hill Education, 2017
2. Clyde F. Coombs, Printed Circuits Handbook, 6th edition, McGraw Hill, 2008
3. S.D. Mehta, Electronic Product Design, 1st edition, S Chand &Company, 2011

Web-based/Online Resources

- http://www.wikihow.com/Create-Printed-Circuit- Boards
- http://reprap.org/wiki/MakePCBInstructions#Making PCBs yourself

List of Hardware required for a batch of 30 students

Sl.No.	Name of the Equipment	Quantity
1	Desktop PC	15
2	Printer	1
3	Soldering Iron	5
4	Drilling machine with drill bit for PCB hole purpose	5
5	Copper clad sheet	30

List of Software

Open Source EDA software

1020236246	Electric Vehicle Technology	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

The world is transitioning to cleaner mobility options with the aim at improving air quality and reducing dependency on fossil fuels. Electric Vehicles (EVs) have emerged as a popular clean mobility choice to reduce emissions. EVs are powered fully or partially by batteries, they can help to reduce dependence on fossil fuels and also air quality.

Course Objectives:

The objective of this course is to enable the students to

- Learn and practice the charging systems of Electric Vehicles.
- Understand the concept of Electric Vehicle components.
- Study the configurations of Electric Vehicles and assemble.

Course Outcomes

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

CO1: Describe the electric vehicle and sub systems.

CO2: Demonstrate and test the EV battery and charging system.

CO3: Apply the procedures and testing of electric components and their accessories.

CO4: Test, diagnose and service the given electric two-wheeler.

CO5: Construct and test the electric Three-wheeler.

Pre-requisites:

Nil

1020236246	Electric Vehicle Technology	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	-	-	-	1	-	-
CO2	2	1	-	2	-	-	1
CO3	1	1	1	2	-	-	1
CO4	1	1	1	2	-	-	1
CO5	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.
- 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.
- The industry session shall be addressed by industry experts (in contact mode/online / recorded video mode) in the discipline only.

1020236246	Electric Vehicle Technology	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	Practical Test	Practical Examination
Portion	Cycle I Exercises	Cycle II Exercises	All Portions	All Exercises	All Exercises Experiments
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Internal Marks	40				
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

1020236246	Electric Vehicle Technology	L	T	P	C
PRACTICUM		1	0	4	3

Practical documents should be maintained for every 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.

The details of the documents to be prepared as per the instruction below.

Each exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment.

This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The Procedure, Sketch and Result / Output should be written by the student manually in the documents.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DoTE Official.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Explanation	10
B	Observation/ Assembly/ Reading	20
C	Test Report	20
TOTAL		50
D	Practical Documents (As per the portions)	10
		60

Cycle - I - Exercise 1, 2, 3,4 and 5.

Cycle - II - Exercise 6, 7, 8, 9 and 10.

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.

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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	10
B	Procedure / Explanation	10
C	Observation/ Assembly/ Reading	20
D	Test Report	20

1020236246	Electric Vehicle Technology	L	T	P	C
PRACTICUM		1	0	4	3

E	Written Test (Theory Portions)	30
F	Viva Voce	10
TOTAL		100

Note: For the written test 30 MCQ shall be asked from the theory portions.

Syllabus Contents

Theory Portion - Electric Vehicle and accessories	
Environmental impact of conventional vehicle - Air pollution –History of Electric vehicles – Need for Electric Vehicle. Battery Electric Vehicle (BEV) –Block diagram of BEV - Major Components of Electric Vehicle – Working of BEV. Battery: Construction and working of Lead Acid and Lithium Based Batteries – Battery Management System. Battery Charging Techniques: Battery Charging techniques – Constant current and Constant voltage, Trickle charging – Battery Swapping Techniques. Types of EV motors - Permanent Magnetic BrushLess DC Motor Drives (BLDC) – Principles, Construction and Working – Hub motor Drive system – Merits and Demerits of DC motor drive, BLDC motor drive. Power Converters: Role of Power Converters – Block diagram of Power Converters in EV – Types of Power Converters – DC to DC Converter, Inverter and Rectifier. Electronics Power Steering – Torque Sensor – EPS Motor – Regenerative Suspension System –Regenerative Braking system. Tamil Nadu EV Policy 2019 & 2023.	15
Practical Exercises	
Experiment 1: Battery Testing – Specific Gravity Test, Open volt testing, Cell voltage tester.	5

1020236246	Electric Vehicle Technology	L	T	P	C
PRACTICUM		1	0	4	3

Experiment 2: Test the Lead acid Battery using voltage Load tester and test the battery pack supply to glow the Head lamp.	5
Experiment 3: Test the battery charging (Series and Parallel) and note the various charging parameters.	5
Experiment 4: Identify and test EV components. (Controller, Throttle, EV motor, Power ON Key, brake, indicator, horn and headlight)	5
Experiment 5: Construct and testing of BLDC Motor with throttle control.	5
Experiment 6: Test the Inverter circuit and buck converter circuit.	5
Experiment 7: Assemble and test E-bicycle with wiring harness.	5
Experiment 8: Assemble and test E-Bike with a central drive mechanism (Chain drive) with wiring harness.	5
Experiment 9: Assemble and test E-Auto rickshaw with differential and wiring harness.	5
Experiment 10: Plan maintenance and servicing schedule of electric two-wheeler.	5
Assessment Test and Revision	10
Total	75

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course.

Text and Reference Books:

1. A.K Babu, Electric & Hybrid Vehicle, Khanna Publication, New Delhi – 2018 Edition
2. Iqbal Husian, Electric and Hybrid Vehicle Design Fundamentals, CRC Press, Boca Raton, Florida
3. Comparison of Electric and Conventional Vehicles in Indian Market: Total Cost of Ownership, Consumer Preference and Best Segment for Electric Vehicle (IJSR), Akshat Bansal, Akriti Agarwal

4. Tamil Nadu Electric Vehicles Policy 2019 & 2023 .
5. Design and analysis of aluminum/air battery system for electric vehicles, Shaohua Yang, Harold Knickle, Elsevier.
6. Propelling Electric Vehicles in India, Technical study of Electric Vehicles and Charging Infrastructure

Web-based/Online Resources:

1. NPTEL Fundamentals of Electric vehicles: Technology & Economics https://nptel.ac.in/courses/108106170
2. NPTEL Introduction to Hybrid and Electric Vehicles, IIT Guwahati https://nptel.ac.in/courses/108103009

END SEMESTER EXAMINATION - Practical Exam

Note:

All the exercises should be completed before the Board Practical Examinations. End Semester Practical examination should be conducted for all the exercises / experiments for 100 Marks. Students will be permitted to select any one exercise by lot or question paper supplied by the DOTE Exam section shall be used. The practical document prepared by the student should be submitted with a Bonafide Certificate.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	10
B	Procedure / Explanation	10

1020236246	Electric Vehicle Technology	L	T	P	C
PRACTICUM		1	0	4	3

C	Observation/ Assembly/ Reading	20
D	Report	20
E	Written Test (Theory Portions)	30
F	Viva Voce	10
TOTAL		100

Note: For the written test 30 MCQ shall be asked from the theory portions.

Equipment / Facilities required to conduct the Practical Course.

Sl. No.	Machines / Tools / Equipments	Quantity
1.	Lead acid battery / Lithium-ion battery	8 Nos.
2.	Battery Load tester	1 No.
3.	Specific gravity tester- Hydrometer	2 Nos.
4.	Cell voltage tester (High Discharge Tester)	1 No.
5.	Buck Converter	2 Nos.
6.	Battery Charger	1 No.
7.	Inverter Trainer Kit	1 No
8.	BLDC motor control Trainer kit or accessories	1 No
9.	Two-wheeler Wiring Harness board or kit	1 No
10.	E – Bicycle kit or Accessories 1. 24V DC Controller, 24 V DC motor 2. Throttle, Brake, Power ON key 3. Head lamp with Horn	1 No
11.	E – Bike kit or Accessories	1 No

	1. 48 V BLDC Controller, 500W or 750 W, 48 V BLDC motor, Throttle, Brake, Power ON key, Display Board, Head lamp with Horn, Left & Right Indicator	
12.	E-Auto Rickshaw 500 W or 750 W, 48 V BLDC motor with differential arrangement 1. Throttle 2. Brake 3. Power ON key 4. Display Board 5. Head lamp with Horn 6. Left & Right Indicator	1 No
13.	**Consumable: -** • Battery Cell - 1.5 V or 3.65 V • Soldering Iron • Flux • De-solder gun or Solder wick • Lead • **Tools** • Continuity Tester • Line Tester • Multi-meter • Screw Drive set & Spanner set	As per requirement

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Reverse Engineering (RE) has become an important Engineering task to obtain knowledge about engineering devices or systems. RE is an effective learning technique if other "solutions" are available on the market.

Course Objectives:

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

- Understand basic engineering systems.
- Understand the terminologies related to re-engineering, forward engineering, and reverse engineering.
- Disassemble products and specify the interactions between its subsystems and their functionality
- Understand Reverse Engineering methodologies.
- Understand Reverse engineering of Systems, Mechanical RE.

Course Outcomes

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

CO1: Explain the fundamental concepts and principles of reverse engineering in product design and development.

CO2: Describe the principles of material characteristics, part durability and life limitation in reverse engineering

CO3: Apply the principles of material identification and process verification in product design and development.

CO4: Explain the principles of rapid prototyping

CO5: Analyze the various legal aspect and applications of reverse engineering in product design and development

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites:

Material Science, Machine Design, Machine Drawing and Value Engineering.

CO/PO Mapping

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

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

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

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Cycle I Exercises	Cycle II Exercises	All Portions	All Exercises	All Exercises Experiments
Duration	2 Periods	2 Periods	3 Hours	3 Hours	3 hours
Exam Marks	60	60	100	100	100
Converted to Marks	10	10	15	15	60
Marks	10		15	15	60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Practical documents should be maintained for every 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.

The details of the documents to be prepared as per the instruction below.

Each exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment.

This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The Procedure, Sketch and Result / Output should be written by the student manually in the documents.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DoTE Official.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	10
B	Procedure / Explanation	20
C	Presentation	20
TOTAL		50
D	Practical Documents (As per the portions)	10
		60

Cycle - I - Exercise 1, 2, 3,4 and 5.

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Cycle - II - Exercise 6, 7, 8 and 9.

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.

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. 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	10
B	Procedure / Explanation	20

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

C	Presentation	20
D	Result	10
E	Written Test	30
F	Viva Voce	10
TOTAL		100

Note: For the written test 30 MCQ shall be asked from the theory portions.

Syllabus Contents

Unit I	**Introduction**	
Theory: Definition – Uses – the Generic Process – Phases – Computer Aided Reverse Engineering - Surface and Solid Model Reconstruction – Dimensional Measurement – Prototyping.		3
Practical: 1. Prepare case study report – various type of rapid Proto type also write the technical difference.		6
UNIT II	**MATERIAL IDENTIFICATION AND PROCESS VERIFICATION**	
Theory: Material Specification, Composition Determination, Microstructure Analysis, Manufacturing Process Verification.		3
Practical: 2. Material Strength Testing: Compare the strength properties of different materials commonly used in automobile components, such as steel, aluminum, and composite materials. Perform tensile, compressive, and bending tests to determine their suitability for various vehicle types. **3.** Impact Resistance Analysis: Test the impact resistance of different Automobile body materials by subjecting them to controlled impacts. Measure and compare the deformation and damage caused by impacts of varying		12

intensity.		
Unit III	**MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION**	
Theory: Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure		3

Practical: Structural Rigidity Testing: Conduct bending and torsion tests on Automobile body frames to determine their structural rigidity. Compare different frame designs and materials to identify the most robust and lightweight options.		5
Unit IV	**RAPID PROTOTYPING(RP)**	
Theory:, Introduction, current RP techniques and materials, Stereo Lithography, Selective Laser Sintering, Fused Deposition Modeling, Three-dimensional Printing, Laminated Object Manufacturing, Multijet Modeling.		3
Practical: 2. Crash Testing Simulation: Utilize crash test dummies and acceleration sensors to simulate vehicle collisions. Study how different body designs and materials affect passenger safety and structural integrity during impact. 3. Prepare case study report - Rapid Prototyping – Any one mechanical Machine components (Impeller, Engine Block, Piston and Door Pad)		12
Unit V	**INDUSTRIAL APPLICATIONS**	
Theory: Reverse Engineering in the Automotive Industry; Aerospace Industry. Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.		3

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

Practical: 4. Prepare case study report – Patent 5. Prepare case study report – Copy rights 6. Prepare case study report – Trade Mark	15
Assessment + Revision	**10**
TOTAL	**75**

Text and Reference Books:

1. Reverse Engineering: An Industrial Perspective by V. Raja and K. Fernandes, Springer-Verlag.Wego

2. Kevin Otto , "Product Design : Techniques in Reverse Engineering and New Product Development", ISBN-13: 9788177588217, Dorling Kindersley

3. Robert Messler, "Reverse Engineering: Mechanisms, Structures, Systems & Materials", McGraw Hill Education, ISBN: 9780071825160

4. Reverse Engineering by K. A. Ingle, McGraw-Hill.

5. Raja, Vinesh, Fernandes, Kiran J. , "Reverse Engineering An Industrial Perspective" ISBN 978-1-84628-856-2, Springer

END SEMESTER EXAMINATION - Practical Exam

Note:

All the exercises should be completed before the Board Practical Examinations. End Semester Practical examination should be conducted for all the exercises / experiments for 100 Marks. Students will be permitted to select any one exercise by lot or question paper supplied by the DOTE Exam section shall be used. The practical document prepared by the student should be submitted with a Bonafide Certificate.

1020236247	REVERSE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	10
B	Procedure / Explanation	20
C	Presentation	20
D	Result	10
E	Written Test	30
F	Viva Voce	10
TOTAL		100

Note: For the written test 30 MCQ shall be asked from the theory portions.

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Traditional energy sources such as coal, oil, and natural gas contribute significantly to greenhouse gas emissions, air pollution, and environmental degradation. By transitioning to green energy sources such as solar, wind, hydroelectric, and biomass, engineers can mitigate these harmful effects while meeting the growing global demand for energy. The green energy projects often have lower life cycle carbon footprints compared to conventional energy sources, making them essential for achieving climate targets and promoting sustainable development. In essence, incorporating green energy into engineering practices is not only necessary for addressing environmental concerns but also essential for creating a resilient, equitable, and prosperous future for all.

Course Objectives:

The objective of this course is to prepare the student,

- To impart knowledge on solar energy collection and to demonstrate practical applications and benefits of solar panels and energy storage systems.
- To understand the principles of wind energy and biomass energy.
- To impart knowledge about geothermal heat pumps, ocean thermal energy conversion (OTEC), and their feasibility.
- To provide fundamental principles of energy-efficient appliances, building designs, and smart systems.
- To acquire knowledge regarding sustainable manufacturing process and to explore on eco-friendly production processes, materials, and waste reduction strategies.

Course Outcomes

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

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

CO1 - Acquire the knowledge of the principles of solar energy conversion and their benefits.

CO2 - Enable for building a small range of wind energy conversion system.

CO3 - Gain knowledge on the various classification of energy sources and their environmental issues.

CO4 - Analyze the limitless availability of green energy sources and understand the challenges in renewable hybrid system.

CO5 - learn hydrogen production method, storage methods and waste reduction strategies.

Pre-requisites:

Knowledge of basic energy sources.

CO/PO Mapping

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

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

- 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.

Assessment Methodology:

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

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above 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 shall be converted to 10 Marks for each assessment test. Best of one will be considered for the internal assessment of 10 Marks.

Practical documents should be maintained for every 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.

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The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DoTE Official.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim / Procedure	10
B	Block diagram / Explanation	20
C	Presentation / Report	20
TOTAL		50
D	Practical Documents (As per the portions)	10

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

	60

Cycle - I - Exercise 1, 2, 3,4 and 5.

Cycle - II - Exercise 6, 7, 8, 9 and 10.

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.

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: 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 practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Aim / Procedure	10
B	Block diagram / Explanation	20
C	Presentation / Report	20
D	Result / Output	10
E	Written Test (Theory Portions)	30
F	Viva Voce	10
TOTAL		100

Note: For the written test 30 MCQ shall be asked from the theory portions.

Syllabus Contents

UNIT I	SOLAR ENERGY & WIND ENERGY	
INTRODUCTION Overview of conventional & renewable energy sources, types of renewable energy systems, Future of Energy Use, Present Indian and international energy scenario of conventional and RE sources, Energy for sustainable development, Environmental Aspects of Energy, Limitations of RE sources. **SOLAR ENERGY & WIND ENERGY** Theory of solar cells - Concept of Solar PV systems - Flat plate and concentrating collectors, Solar PV Applications - solar heating/cooling technique, solar distillation		7

and solar drying, solar cookers. Energy from Wind - Horizontal axis Wind Turbine - Vertical Axis Wind Turbine - Wind Energy Conversion Systems	
Familiarization with Different Solar Energy Gadgets	
Exercise 1: Study of Solar Distillation System	5
Exercise 2: Performance test on Solar Cooker	5
Exercise 3: Performance analysis of Solar Water Heater	5
Exercise 4: Performance test on Solar Dryer	5
Exercise 5: Performance Evaluation on Solar Lighting System	5

UNIT II	GEOTHERMALENERGY, BIOMASS, HYDROGEN STORAGE, ENERGY EFFICIENT SYSTEMS & GREEN MANUFACTURING SYSTEMS	
OCEAN ENERGY, BIO-MASS ENERGY & HYDROGEN PRODUCTION OTEC, Principles of utilization, setting of OTEC plants - Tidal and wave energy. Principles of bio-conversion - types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects. Chemical Production of Hydrogen- Electrolytic Hydrogen- Thermolytic Hydrogen- Photolytic Hydrogen- Photobiologic Hydrogen Production **ENERGY EFFICIENT & GREEN MANUFACTURING SYSTEMS** Energy efficient motors, energy efficient lighting and control. Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps. Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, Sustainable green production systems - alternate casting and joining techniques, zero waste manufacturing.		8

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

Exercise 6: Study on the Production Process of Bio-Fuels	5
Exercise 7: Study on the Floating Drum & Fixed Drum Biogas Plants	5
Exercise 8: Study on the various Bio-mass energy conservation technologies.	5
Exercise 9: Study on Production Process of Briquettes	5
Exercise 10: Performance test on BIO Diesel using blend analyzer	5
Revision + Assessment Test	10

Text and Reference Books:

1. D. S. Chauhan & S. K. Srivastava, Non-Conventional Energy Resources, New Age International Private Limited, 4 th Edition, 2021.
2. John Twidell & Tony Weir, Renewable Energy Resources, Routledge; 3 rd Edition, 2015.
3. D.P. Kothari, K.C. Singal & Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning; 3 rd Edition, 2022.
4. Ritu Dogra, Renewable Energy and Green Technology, Brillion Publishing, 1 st Edition, 2023.
5. Soli J. Arceivala, Green Technologies, McGraw Hill Education (India) Private Limited, 1 st Edition, 2017.
6. Chandan Deep Singh & Harleen Kaur, Sustainable Green Development and Manufacturing Performance through Modern Production Techniques, Taylor & Francis Ltd, 1 st Edition, 2021.

Web and Online Resources

- https://onlinecourses.nptel.ac.in/noc21_ch11/preview

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

END SEMESTER EXAMINATION - Practical Exam

Note:

All the exercises should be completed before the Board Practical Examinations. End Semester Practical examination should be conducted for all the exercises / experiments for 100 Marks. Students will be permitted to select any one exercise by lot or question paper supplied by the DOTE Exam section shall be used. The practical document prepared by the student should be submitted with a Bonafide Certificate.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	10
B	Procedure / Explanation	20
C	Presentation	20
D	Result	10
E	Written Test (Theory Portions)	30
F	Viva Voce	10
TOTAL		100

Note: For the written test 30 MCQ shall be asked from the theory portions.

1020236248	Green Energy & Engineering	L	T	P	C
PRACTICUM		1	0	4	3

List of Equipment required.

S.No	Name of the Equipment	Quantity required
1	Solar PV Panel	1
2	Solar Current lamp	2
3	PV analyser	1
4	Solar Irradiation Meter	1
5	Solar Cooker	1
6	RTD - 2 mts	10 Qty
7	Solar Dryer	1
8	Pyranometer	2
9	Axial Fan	1
10	Biodiesel	2 lt
11	Biodiesel blend analyse	1
12	Solar Water Heater	1
Consumables and instruments		Sufficient quantity

1047235654	Innovation & Startup	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 organizations

Course Objectives

The objective of this course is to enable the students

- To understand the concept of Innovation and Start-ups.
- To acquire knowledge of Prototype development, IPR, Patents and Copyrights.
- To have practical experience in preparing Business plan for Start-ups.
- To visit the existing nearby industry to prepare a project report about the present challenges of that industry.
- To know the different funding supports available from Government and Non-Government schemes for Start-ups.

1047235654	Innovation & Startup	L	T	P	C
PRACTICUM		1	0	2	2

Course Outcomes

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

CO 1: Differentiate between Innovation and Start-ups

CO 2: Explain the importance of IPR, Patents and Copyrights.

CO 3: Describe the methodology to be adopted for preparing the Business Plan

CO 4: Gain practical experience by Industrial training and visiting the nearby industry

Co 5: Explore and identify various funding facilities available from Government and Non-Government Schemes for Start-ups

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

1047235654	Innovation & Startup	L	T	P	C
PRACTICUM		1	0	2	2

CO5	-	-	1	-	2	3	3

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

1047235654	Innovation & Startup	L	T	P	C
PRACTICUM		1	0	2	2

Assessment Methodology

	Continuous Assessment (40 marks)			**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	
Mode	Class Assessment (Unit I, II & Unit III)	Seminar Presentations (Unit IV)	Submission of Industry Visit Project Report (Unit V)	Practical Examination (Project)
Duration	2 hours	---	---	3 hours
Exam Marks	50	20	30	100
Converted to	10	10	20	60
Marks	**10**	**10**	**20**	**60**

Continuous Assessment - 40 marks

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**

1047235654	Innovation & Startup	L	T	P	C
PRACTICUM		1	0	2	2

Syllabus Contents

UNIT I	**INTRODUCTION TO INNOVATION**	
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**	
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**	
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
UNIT IV		
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.		9

1047235654	Innovation & Startup	L	T	P	C
PRACTICUM		1	0	2	2

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.		
UNIT V	**EXPOSURE TO INDUSTRY**	
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		**45**

1047235654	Innovation & Startup	L	T	P	C
PRACTICUM		1	0	2	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.

Detailed Allocation of Marks

S. No	Description	Marks
Part A	Written Examination – Unit –I,II & III Theory Questions	45
i)	10 questions out of 15 questions (10 x 3 marks = 30 marks)	
ii)	3 questions either or pattern (3 x 5 marks = 15 marks)	
Part B i)	Presentation of Industry Visit Project Report	25
ii)	Interaction and Evaluation	30
	TOTAL	**100**

<table>
<tr><td>1047235773</td><td rowspan="2">**Industrial Training**</td><td rowspan="2">Summer Vacation</td><td>C</td></tr>
<tr><td>Internship</td><td>2</td></tr>
</table>

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.

<table>
<tr><td>1047235773</td><td rowspan="2">Industrial Training</td><td rowspan="2">Summer Vacation</td><td>C</td></tr>
<tr><td>Internship</td><td>2</td></tr>
</table>

- 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

CO 1: Demonstrate proficiency in using industrial machinery, tools, and software.

CO 2: Able to identify, analyze, and solve engineering problems using industry-standard methods and practices.

CO 3: Gain a comprehensive understanding of industrial manufacturing processes, quality control, and safety practices.

CO 4: Exhibit improved communication, teamwork, and professional behavior in an industrial setting.

CO 5: Apply theoretical concepts learned in their coursework to practical engineering tasks and projects.

Duties Responsibilities of the Faculty Mentor.

1047235773	**Industrial Training**	Summer Vacation	C
Internship			2

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.

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.

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

1047235773	**Industrial Training**	Summer Vacation	C
Internship			2

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

<table>
<tr><td>1047235773</td><td rowspan="2">Industrial Training</td><td rowspan="2">Summer Vacation</td><td>C</td></tr>
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</table>

B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Self expression / communication skills. Interpersonal skills / Human Relation.	10
D	Report and Presentation.	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 industrial training. The marks scored will be converted to 60 marks for the End Semester Examination.

Scheme of Evaluation

Sl. No.	Description	Marks
A	Daily Activity Report and Attendance certificate.	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

Regulation 2023

Program Structure

Diploma in Mechatronics

VI SEM 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 students to

1. Understand the concepts of eigen-values and eigen-vectors of matrices.
2. Learn the notation of partial differentiation and determine the extremities of functions of two variables.
3. Acquire knowledge in vector calculus which is significantly used to solve engineering problems.
4. Formulate and solve differential equations.
5. Understand Laplace transformation and its engineering applications.

Course Outcomes

After successful completion of this course, the students should 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

Matrices, Determinants, 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 an 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.

6000236111	Advanced Engineering Mathematics	L	T	P	C
THEORY		3	0	0	3

- State the need for mathematics with engineering studies and provide real-life examples.

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

6000236111	Advanced Engineering Mathematics	L	T	P	C
THEORY		3	0	0	3

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

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

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

Unit I	**EIGENVALUES AND EIGENVECTORS**	
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.		7
Unit II	**FUNCTIONS OF SEVERAL VARIABLES**	
Partial derivatives of two variable and three variable functions (up to second		7

6000236111	Advanced Engineering Mathematics	L	T	P	C
THEORY		3	0	0	3

order) – Homogeneous functions and Euler's theorem (excluding proof) – Jacobian matrix and determinant – Maxima and minima of functions of two variables – Simple problems.		
Unit III	**VECTOR CALCULUS**	
Scalar field 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.		7
Unit IV	**DIFFERENTIAL EQUATIONS**	
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 $(\ ^2 + \ + \ ) =$ where , , and are constants and the auxiliary equation $^2 + \ + \ = 0$ has only real roots) – Complementary function – Particular integral – General solution – Simple problems.		7
Unit V	**LAPLACE TRANSFORMS**	
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.		7
Revision + Test		10
TOTAL HOURS		45

Suggested list of Students Activity,

6000236111	Advanced Engineering Mathematics	L	T	P	C
THEORY		3	0	0	3

- 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.
- Quizzes.

Reference Books:

1. John Bird, Higher Engineering Mathematics, Routledge, 9th Edition, 2021.
2. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 42nd Edition, 2012.
3. Arumugam, S., Thangapandi Isaac, A., & Somasundaram, A., Differential Equations and Applications, Yes Dee Publishing Pvt. Ltd., 2020.
4. Duraipandian, P., & Kayalal Pachaiyappa, Vector Analysis, S Chand and Company Limited, 2014.
5. Narayanan, S., & Manicavachagom Pillai T.K., Calculus Volume I and II, .Viswanathan Publishers Pvt. Ltd., 2007.

Web Reference

1. https://www.khanacademy.org/math/
2. https://www.mathportal.org/
3. https://openstax.org/subjects/math/
4. https://www.mathhelp.com/
5. https://www.geogebra.org/
6. https://www.desmos.com/
7. https://phet.colorado.edu/

6000236111	Advanced Engineering Mathematics	L	T	P	C
THEORY		3	0	0	3

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

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 aspirations 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 promote 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 ensuring good means of living for every individual, providing jobs and developing the Indian economy.

Course Objectives

After completing this subject, the student will be able 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

CO1: Explain 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 basics of 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 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.

6000236112	Entrepreneurship	L	T	P	C
THEORY		3	0	0	3

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

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

6000236112	Entrepreneurship	L	T	P	C
THEORY		3	0	0	3

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

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

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

Unit I	**Entrepreneurship – Introduction and Process**	
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		7
Unit II	**Business Idea**	

6000236112	Entrepreneurship	L	T	P	C
THEORY		3	0	0	3

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,	7

Unit III	Banking	
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.		7
Unit IV	**Pricing and Cost Analysis**	
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.		7
Unit V	**Business Plan Preparation**	
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.		7

6000236112	Entrepreneurship	L	T	P	C
THEORY		3	0	0	3

Revision + Test	10
TOTAL HOURS	45

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:

1. G.K. Varshney, Fundamentals of Entrepreneurship, Sahitya Bhawan Publications, Agra., 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 Reference:

6000236112	Entrepreneurship	L	T	P	C
THEORY		3	0	0	3

- https://ocw.mit.edu/courses/15-390-new-enterprises-spring-2013/resources/lecture-1/
- https://onlinecourses.nptel.ac.in/noc20_ge08/preview

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

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

After completing this subject, the student will be able,

- To understand the concept, characteristics and elements of projects.
- To understand the stages in Project Life Cycle.
- To appreciate the need for Project Portfolio Management System.
- To know the considerations in choosing appropriate project management structure.
- To understand the components of techno-economic feasibility studies.
- To know about the detailed project report
- To learn about project constraints.
- To understand the techniques of evaluation.
- To get insight into the Social Cost Benefit Analysis Method.
- To know how to construct project networks using PERT and CPM.
- To learn how to crash project networks
- To understand the meaning of project appraisal.
- To understand the meaning of project audits.
- To know the qualities of an effective project manager.
- To understand the stages in the Team Development model.

6000236113	Project Management	L	T	P	C
THEORY		3	0	0	3

Course Outcomes

CO 1: Explain the principles of Project Management

CO 2: Create and manage project schedules.

CO 3: Create structure and manage the project commitments.

CO 4: Acquire to Gain enterprise support.

CO 5: Prepare a Detailed Project Report (DPR).

Pre-requisites

Basic Knowledge.

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

6000236113	Project Management	L	T	P	C
THEORY		3	0	0	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.
- 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 (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100

6000236113	Project Management	L	T	P	C
THEORY		3	0	0	3

Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1and CA2, Assessment test should be conducted for two units as below.

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

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

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

6000236113	Project Management	L	T	P	C
THEORY		3	0	0	3

Unit I	**Project Management – An Overview, Project Portfolio Management System and Structure, Steps in Defining Project and Project Delays**	
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.		7
Unit II	**Various Stages and Components of Project Feasibility Studies, Phases of a Project, Stages in Project Life Cycle and Project Constraints**	
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.		7
Unit III	**Project Evaluation under Certainty and Uncertainty, Project Evaluation, Commercial and Social Cost Benefit Analysis**	
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.		7
Unit IV	**Developing Project Network using PERT and CPM, Project Appraisal and Control Process.**	

6000236113	Project Management	L	T	P	C
THEORY		3	0	0	3

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.	7

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.**
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.	7
Revision + Test	10
TOTAL HOURS	45

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.

6000236113	Project Management	L	T	P	C
THEORY		3	0	0	3

- 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.

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 Reference

https://youtu.be/pc9nvBsXsuM

NPTEL Courses

https://youtu.be/PqQqTAu_FiM

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

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

1. Identify different ways to save money for future
2. Understand various techniques to raise capital
3. Get acquainted with the essential terminologies used in finance language
4. Get exposed to different types of budgeting
5. Instill the concept of costing and its impact on profitability

Course Outcomes

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

CO1: Manage financial resources effectively to achieve personal goals

CO2: Explain the procedure for Business Funding

CO3: Exhibit financial literacy through the usage of different terminologies appropriate to the context

CO4: Differentiate the types of budgeting and allocate the resources

CO5: Apply the idea of marginal costing in decision making

Pre-requisites

Knowledge of basic mathematics

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	3		-	-	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 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.

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1and CA2, Assessment test should be conducted for two units as below.

6000236114	Finance Fundamentals	L	T	P	C
THEORY		3	0	0	3

(5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

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

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

UNIT I	**Personal Finance**	
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).		7
UNIT II	**Business Funding**	

6000236114	Finance Fundamentals	L	T	P	C
THEORY		3	0	0	3

Sources: Personal Savings – Borrowings - Venture Capital – Venture Capital Process – Commercial Banks – Government Grants and Scheme.		7
UNIT III	**Finance language**	
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 – Shareholders fund: Equity Share capital, Preference Share Capital, Reserve & Surplus – Borrowings: Debentures, Bank Loan, Other Loan – Depreciation – Reserve Vs Provision.		7
UNIT IV	**Budgeting**	
Budgetary Control – Meaning – Preparation of various budgets – Purchase budget – Sales Budget – Production budget – Cash Budget – Flexible budgets. (With Problems)		7
UNIT V	**Marginal Costing**	
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)		7
Revision + Test		10

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.

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.

Reference Books:

1. Banking Theory, Law & Practice - Dr.L.Natarajan, Margham Publications.
2. Corporate Accounting by T.S.Reddy and Dr.A.Murthy, Margham Publications.
3. Management Accounting by T.S.Reddy and Dr.Y.Hariprasd Reddy, Margham Publications.
4. Cost Accounting by T.S.Reddy and Dr.Y.Hariprasd Reddy, Margham Publications.

6000236114	Finance Fundamentals	L	T	P	C
THEORY		3	0	0	3

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hours. **Maximum Marks: 100**

Note: Answer Ten questions by selecting Two questions from each unit. Each question carries 10 marks.

Instruction to the question setters.

Each unit should have four questions. Each question carries 10 Marks. Each question may have two subdivisions only.

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	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.

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

1030236115	INDUSTRIAL MANAGEMENT AND SAFETY	L	T	P	C
THEORY		3	0	0	3

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.

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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1020236115	Industry 4.0	L	T	P	C
THEORY		3	0	0	3

Introduction

Industry 4.0, also known as the Fourth Industrial Revolution, represents the current trend of automation and data exchange in manufacturing technologies. It integrates advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), cloud computing, and big data analytics to create "smart factories" that are highly efficient and adaptive.

Industry 4.0 is transforming the manufacturing landscape by leveraging advanced technologies to create more efficient, flexible, and intelligent production processes. For diploma engineering students, understanding these concepts is crucial as they will play a key role in the future of engineering and manufacturing. Learning Industry 4.0 will not only enhance your technical skills but also prepare you for the evolving job market in the digital age.

Course Objectives

The objective of this course is to prepare the student,

- To understand the basics of Technology of Industry 4.0 and IoT
- To learn about the Artificial Intelligence and Application Domains
- To study Robotic Process Automation and programming.
- To understand the Augmented & Virtual Reality and its applications
- To learn and evolution of IoT, Sensors, and Actuators

Course Outcomes

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

CO1: Describe the Industry 4.0 technology and Industrial Internet of Things

CO2: Explain the Artificial Intelligence (AI) and Future Prospects of AI.

CO3: Explain Robotic Process Automation (RPA) for Manufacturing Industry

CO4: Describe Augmented & Virtual Reality and its Applications.

CO5: Explain the applications of IoT, Sensors, and Actuators in industries

Pre-requisites

1020236115	Industry 4.0	L	T	P	C
THEORY		3	0	0	3

Basic Knowledge of Industry 4.0 and its Applications

CO/PO Mapping

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

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

Assessment Methodology

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written test (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60

1020236115	Industry 4.0	L	T	P	C
THEORY		3	0	0	3

Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1and CA2, Assessment test should be conducted for two units as below.

Answer five questions (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

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

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1020236115	Industry 4.0	L	T	P	C
THEORY		3	0	0	3

Syllabus Contents

Unit I:	**Introduction to Industry 4.0**	
Need – Reason for Adopting Industry 4.0 - Definition – Goals and Design Principles - Technologies of Industry 4.0 – Big Data – Artificial Intelligence (AI) – Industrial Internet of Things - Cyber Security – Cloud – Augmented Reality.		7
Unit II:	**Artificial Intelligence**	
Artificial Intelligence: Artificial Intelligence (AI) – What & Why? - History of AI - Foundations of AI -The AI - Environment - Societal Influences of AI - Application Domains and Tools - Associated Technologies of AI - Future Prospects of AI - Challenges of AI.		7
Unit III:	**Robotic Process Automation (RPA)**	
Robotic Process Automation (RPA): Introduction to RPA – Need for automation – Programming constructs in RPA – Robots and Softbots – RPA architecture and process methodologies - Industries best suited for RPA - Risks & Challenges with RPA.		7
Unit IV:	**Augmented & Virtual Reality**	
Augmented Reality: Definition - Tools for Augmented Reality – Hololens - Advantages and Challenges of AR - Applications of AR in Education, Industries - Mixed Reality. Virtual Reality: Definition – Types of Head Mounted Displays – Tools for Virtual Reality – Applications of VR in Education, Industries - Difference between VR and AR.		7

1020236115	Industry 4.0	L	T	P	C
THEORY		3	0	0	3

Unit V:	**IoT, Sensors and Actuators**	
Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT – Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT Analog and Digital Sensors – Interfacing temperature sensor, ultrasound sensor and infrared (IR) sensor with Arduino – Interfacing LED and Buzzer with Arduino.		7
	Assessment Test and Revision with Student activity	10
	Total	45

Textbook:

1. Sudip Misra, Chandana roy, and Anandarup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, Taylor & Francis India, 2021.
2. Dr Anand Kumar Singh and Dr. Manish Gangil, INDUSTRY 4.0, Shashwat Publication, 2022.
3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017.
4. Dr Kamlesh Lakhwani, Dr Hemant Kumar Gianey, Joseph Kofi Wireko, and Kamal Kant Hiran, Internet of Things (IoT), First Edition, BPB Publications, 2020.

Website links for reference:

- https://www.youtube.com/playlist?list=PLbRMhDVUMngdcLdH4-YF1uJI4IuhcDZPR

1020236115	Industry 4.0	L	T	P	C
THEORY		3	0	0	3

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hrs. **Max. Marks: 100**

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Instruction to the Question Setters

Four questions will be asked from every unit, students should write any two questions for 10 marks. The question may have two subdivisions only.

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

Introduction

This course is mainly designed to have a complete knowledge about Additive Manufacturing technologies which is a main component among the nine pillars of Industrie 4.0. This course is suitable for students opting for any pathway under Diploma in Mechanical Engineering stream. This course enhances the technical skills of students such as newer product design, testing and validation, problem solving, innovation, etc.

Course Objectives

1. To impart the knowledge of construction and working principles of additive manufacturing technologies, and their potential applications in design and manufacturing.
2. To familiarise with the materials used in AM processes and their applications

Course Outcomes

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

CO1: Explain the additive manufacturing technologies and rapid prototyping
CO2: Acquire the CAD model generation procedure for the AM processes
CO3: Explain extrusion and sheet metal based AM processes
CO4: Describe photo polymerization and powder based AM processes
CO5: Enlighten the various applications of AM processes

Pre-requisites

Knowledge of basic Science, Manufacturing Processes, Machine Tool Technology

1020236116	Additive Manufacturing	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	1		1
CO2	3			1			1
CO3	3			1			1
CO4	3			1			1
CO5	3			1	1		1

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

Instructional Strategy

- Prepare case study problems to the realistic situations, and real-world examples to make the sessions engaging.
- Additive Manufacturing processes can be displayed via online or offline mode to gain the interest for this course.
- Different methods of teaching such as debate and discussions can be used to enhance the students' centric learning.
- Organise demo sessions on the 3D printing machines that are available in the institution or can be call some vendor for giving demos

1020236116	Additive Manufacturing	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 (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1and CA2, Assessment test should be conducted for two units as below.

Answer five questions (5 X 10 Marks = 50 Marks).

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

Eight questions will be asked, students should write Five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

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

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

Unit I	**Introduction to Additive Manufacturing (AM)**	
Additive Manufacturing - Overview – Need – History – Classification – working principles (concepts only) - Materials for AM – PLA, ABS, PMMA, ceramics, composites and liquid resins – AM processes - Advantages, Limitations and Challenges– Rapid Prototyping – Rapid Tooling.		6
Unit II	**Design for Additive Manufacturing**	
Basic concept – CAD model preparation - file formats - Part orientation – Support material generation – Model slicing – honeycomb structure - Digitization techniques – Model reconstruction – Slicing software - Reverse Engineering – RE		6

application in AM.		
Unit III	**Extrusion and Sheet metal based Processes**	
Fused Deposition Modeling (FDM) – construction, working principle, advantages – process parameters involved - Laminated Object Manufacturing (LOM) – construction, working principle, advantages - gluing and adhesive bonding - PolyJet - construction, working principle, advantages.		6
Unit IV	**Photo polymerization and Powder based Processes**	
Stereolithography process (SLA) – construction, photo curable materials, working principle, advantages – Selective Laser Sintering (SLS) - construction, working principle, advantages – Electron Beam Melting (EBM) - construction, working principle, advantages – Laser Engineered Net Shaping (LENS) - construction, working principle, advantages.		6
Unit V	**Applications of Additive Manufacturing**	
Applications of Additive manufacturing technologies – new product development - after sales and service - automobile, aerospace, consumer products, health care industries – customized implants, bio-organs, bio-bones, etc.		6
	Assessment Test and Revision with Student activity	15
	Total	45

Suggested list of Students Activity,

- Selected topics which are relatively simpler or descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Mini-projects may be given to a group of students for hand-on experiences.

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

- Massive open online courses (MOOCs) may be used to teach various topics/subtopics.

Reference Books:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.
3. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
4. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
5. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
6. Tom Page "Design for Additive Manufacturing" LAP Lambert Academic Publishing, 2012.

Web Reference

What is 3D printing? How does a 3D printer work? Learn 3D printing

3D Printing - Applications, Types, Process, Advantages (vajiramandravi.com)

How a 3D Printer Works and What It Is Used for (spiceworks.com)

What is 3D Printing? - Technology Definition and Types - TWI (twi-global.com)

https://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf

https://web.mit.edu/tdp/www/whatis3dp.html

Briefing Note (birmingham.ac.uk)

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

END SEMESTER QUESTION PATTERN - Theory Exam

Duration: 3 Hrs. **Max. Marks: 100**

Note: Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

Instruction to the Question Setters

Four questions will be asked from every unit, students should write any two questions for 10 marks. The question may have two subdivisions only.

1042236115	BIOMEDICAL INSTRUMENTATION	L	T	P	C
THEORY		3	0	0	3

Introduction:

Bio medical engineering education is in the growing stage. But every year, there is a tremendous increase in the use of modern medical equipment in the hospital and health care industry therefore it is necessary for every student to understand the functioning of different medical equipment. This course is to enable the students to learn the basic principles of different bio medical instruments and clinical measurement, Bio-medical recorders, Therapeutic instruments, Biotelemetry and Modern imaging techniques instruments.

Course Objectives:

The objective of this course is to enable the students to

1. Acquire Knowledge on the generation of Bio-potential and its measurement using various electrodes.

   Gain Knowledge on the working principles of operations of ECG recorder, EEG recorder and EMG recorder.
2. Acquire Knowledge on the working principles of audio meter, pacemaker and ventilators.
3. Gain knowledge about the importance of patient safety and various methods of accident prevention.
4. Acquire knowledge on the basic principle of CT, MRI scanner and operation of various imaging techniques.

Course Outcomes:

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

CO1: Explain about Bio - electric signals, electrodes and clinical measurement.

CO2: Explain the construction and working of Bio - medical recorders.

CO3: Explain the construction and working of Therapeutic instruments.

CO4: Explain the construction and working of Biotelemetry and patient safety systems.

CO5: Explain the construction and working of Modern imaging techniques instruments.

Pre-requisites:

Basics of Electronics & Instrumentation, Electronic devices and circuits, Analog and digital electronic circuits.

CO/PO Mapping:

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

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

Instructional Strategy:

5. It is advised that teachers must use different teaching methods to stimulate the interest of students in learning.
6. To help students to learn different types of Diagnostic and Therapeutic equipment, Teachers should use PPT presentation of image and to show video of application of the Diagnostic and Therapeutic Equipment. Also, should explain examples from daily life, realistic situations, and visit hospitals and demonstrate the equipment.
7. Students may be shown all the Diagnostic, Therapeutic, and operating theater equipment in the lab. The demonstration can make the subject exciting and foster in.
8. The students have a scientific mind set. Student activities should be planned on all the topics.
9. Demonstration method may be used with step-by-step procedure to use the diagnostic equipment to diagnose the disease in a human body.
10. Teachers are advised to follow an inductive strategy to help the students to discover the working principle of various diagnostic and therapeutic instruments.

1042236115	BIOMEDICAL INSTRUMENTATION	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 (Two units)	Written test (Another Two units)	Quiz MCQ (Online / Offline)	Model Examination	Written Examination
Duration	2 Periods	2 Periods	1 Hour	3 Hours	3 Hours
Exam Marks	50	50	60	100	100
Converted to	15	15	5	20	60
Marks	15		5	20	60
Tentative Schedule	6th Week	12th Week	13-14th Week	16th Week	

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

CA1 and CA2, Assessment test should be conducted for two units as below.

PART A: (5 X 10 Marks = 50 Marks).

Eight questions will be asked, students should write five questions. Each unit Four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

CA3: 60 MCQ can be asked by covering the entire portion. It may be conducted by Online / Offline.

The marks scored should be converted to 5 marks for the internal assessment.

CA4: Model examination should be conducted as per the end semester question pattern. The marks should be converted to 20 marks for the internal assessment.

Question Pattern:

Answer Ten questions by selecting two questions from each unit. Each question carries 10 marks each.

1042236115	BIOMEDICAL INSTRUMENTATION	L	T	P	C
THEORY		3	0	0	3

Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

1042236115	BIOMEDICAL INSTRUMENTATION	L	T	P	C
THEORY		3	0	0	3

1042236115	Bio Medical Instrumentation	L	T	P	C
Theory		3	0	0	3

Unit I	PHYSIOLOGICAL & CLINICAL MEASUREMENTS	
	Bio Potential and Electrodes : Components of man instrument system – Bio-potential and their generation – resting & action potential. Electrodes -Micro- Skin Surface – Needle electrodes. **Clinical Measurements:** Measurement of blood pressure – Direct method- indirect Method – Blood flow meter - Electromagnetic blood flow meter- Ultrasonic blood flow meter. Measurement of blood pH – CO2 method of respiration rate – Lung Volume – Heart rate	9
Unit II	DIAGNOSTIC INSTRUMENTS	
	Electro cardiograph: 12 Lead systems – ECG recorder – analysis of ECG waves. **Electro Encephalograph:** 10-20% lead System - EEG recorder- EEG wave types **Electro Myograph :** EMG Waves - EMG Recording unit - Measurement of conduction velocity. **Electro Retinograph :** ERG Recording Unit – ERG waves. **Audiometer :** Basic Audiometer Block diagram - Types	9
Unit III	THERAPEUTIC INSTRUMENTS	
	Cardiac pacemaker: Need for pacemaker – Classification – External pacemaker – Implantable pacemaker – Programmable pacemaker. **Cardiac Defibrillators:** Need for defibrillators – Types – AC defibrillators - DC Defibrillators. **Heart lung Machine**: Block Diagram - Oxygenators – Blood pumps. **Dialysis** : Hemo dialysis – peritoneal dialysis – Working	9
Unit IV	BIO – TELEMETRY AND PATIENT SAFETY	
	Bio – Telemetry: Introduction to Bio telemetry - Physiological parameter adaptable to bio telemetry - components of a bio telemetry system – Application of bio telemetry. **Patient Safety:** Physiological effects of electric current – Electrical Shock Hazards- Micro shock – Macro shock- Methods of accident Prevention against electric hazards – GFI – equi potential grounding system.	9

1042236115	BIOMEDICAL INSTRUMENTATION	L	T	P	C
THEORY		3	0	0	3

Unit V	MODERN IMAGING TECHNIQUES	
Laser: Laser – Properties - principles - application of laser in medicine. Operation of Co2 Laser & ND – YAG Laser. **X –Ray:** X-Ray apparatus – Block Diagram – operation - Angiography – CT Scanner. **Ultrasonic imaging Technique** : Echo cardiography – Working – Operating modes **Magnetic resonance imaging Technique** : MRI Scan Principles – Working		9
TOTAL HOURS		45

Suggested List of Activities (upgraded):

1. Students can view the video in YouTube on different kind of Medical instruments being used in hospitals
2. Student can view the procedure of using the Medical instruments in the hospital to Patients in the video
3. Students can visit hospital and can observe the different kind of Medical instruments being used in hospital for diagnosing and therapeutic purpose.
4. Student can try to open the old medical instruments and see the inner parts and circuits and try to debug the problem.
5. Students have to practice the design and construction of Medical electronics circuits
6. Student can read Magazines related to Bio medical equipment in online or in offline
7. Students have to practice to measure Blood pressure using Sphygmomanometer, can practice to take ECG, EEG with the concerned equipment.

Text Books for Reference:

1. Dr.M. Arumugam – Biomedical Instrumentation, Anuradha Publications, Chennai
2. Medicine and clinical Engineering, Jacobson and Webstar, Prentice-Hall
3. Introduction to Biomedical Instrumentation, Mandeep Singh, PHI Learning Pvt. Ltd, 2nd edition 2010

1047236351	Internship	540 Periods	C
PROJECT			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.

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.

1047236351	Internship	540 Periods	C
PROJECT			12

- 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.
- 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

CO 1: Demonstrate improved skills.

CO 2: Exhibit increased professional behavior.

CO 3: Apply theoretical knowledge and principles in real-world practices.

CO 4: Develop and utilize assessment tools to evaluate the learning and practices.

CO 5: Engage in reflective practice to continually improve their learning and professional growth.

Facilitating the Interns by an Internship Provider.

1047236351	Internship	540 Periods	C
PROJECT			12

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.

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.

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 reports in the form of a diary to be submitted to the concerned staff in-charge of the institution. This will be reviewed while awarding Internal

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.

1047236351	Internship	540 Periods	C
PROJECT			12

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.

Scheme of Evaluation

Internal Assessment

Students should be assessed for 50 Marks by industry supervisor and polytechnic faculty mentor during 8th Week and 15th Week. 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

End Semester Examination - Project Exam

1047236351	**Internship**	540 Periods	C
PROJECT			12

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 (Dec - May). 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

1047236353	Fellowship	540 Periods	C
PROJECT			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.

1047236353	Fellowship	540 Periods	C
PROJECT			12

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.

1047236353	**Fellowship**	540 Periods	C
PROJECT			12

Course Outcomes

CO 1: Demonstrate a strong understanding of core engineering principles and possess the technical skills necessary to design, analyze, and implement engineering solutions across various disciplines.

CO 2: Apply theoretical knowledge to practical scenarios, effectively solving engineering problems through hands-on projects, laboratory work, and internships.

CO 3: Exhibit the ability to conduct research, develop innovative solutions, and contribute to advancements in engineering through critical thinking and creative approaches to complex challenges.

CO 4: Understand and adhere to professional and ethical standards in engineering practice, demonstrating responsibility, integrity, and a commitment to sustainable and socially responsible engineering.

CO 5: 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.

1047236353	Fellowship	540 Periods	C
PROJECT			12

- **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.
- 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.

1047236353	Fellowship	540 Periods	C
PROJECT			12

- 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.
- 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.

1047236353	Fellowship	540 Periods	C
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Rubrics for Fellowship. Review I & II.

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).
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.

<table>
<tr><td>1047236353</td><td rowspan="2">Fellowship</td><td rowspan="2">540 Periods</td><td>C</td></tr>
<tr><td>PROJECT</td><td>12</td></tr>
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INTERNAL MARKS - 40 Marks

As per the rubrics each topic should be considered for the Review I and Review II. 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 30 Marks.

Scheme of Evaluation

PART	DESCRIPTION	MARKS
A	Assessment as per the rubrics.	30
B	Attendance	10
Total		**40**

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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

1047236374	In-house Project	540 Periods	C
PROJECT			12

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.

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.

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- **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

CO 1: Demonstrate the ability to apply theoretical concepts and principles learned in coursework to solve practical engineering problems encountered during the project.

CO 2: Develop and enhance technical skills specific to the field of engineering relevant to the project, such as design, analysis, simulation, construction, testing, and implementation.

CO 3: Apply critical thinking and problem-solving skills to identify, analyze, and propose solutions to engineering challenges encountered throughout the project lifecycle.

CO 4: Acquire project management skills by effectively planning, organizing, and executing project tasks within defined timelines and resource constraints.

CO 5: 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.

1047236374	In-house Project	540 Periods	C
PROJECT			12

- 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.
- 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.

1047236374	In-house Project	540 Periods	C
PROJECT			12

- 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 Marks (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.

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 project supervisor and an internal examiner.

1047236374	In-house Project	540 Periods	C
PROJECT			12

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.

2047234274 2047237274	**Industrial Training (SW)**	540 Periods	C
PROJECT			12

Introduction

The main objective of the sandwich Diploma course is to mould a well-rounded technician acclimated with the industrial environment while being a student in the institution. The Sandwich Diploma Course study is pursued by students, in 7 Semesters of 3 ½ years duration, the subjects of 3 years-Full Time Diploma Course being regrouped for academic convenience.

While in the 4th semester students undergo Industrial Training for 6 months (December through May). They also do course work in the institution for one day in a week, While in the 7th semester they undergo another spell of 6 months (June through November) Industrial training.

The Apprenticeship (Amendment) Act 1973 is followed in regulating the Industrial training procedure for Sandwich Course.

Objectives

The main objective of industrial training for a diploma engineer is to provide practical, hands-on experience in real-world industrial settings, bridging the gap between academic learning and professional practice. This training aims to equip students with the skills, knowledge, and competencies required to effectively perform and succeed in the mechanical engineering industry.

Key aspects of this objective include:

- Enable students to apply the concepts and principles learned in the classroom to real-world engineering problems and scenarios.
- Develop essential technical skills.
- Enhance soft skills like communication, teamwork, problem-solving, and time management.
- Provide exposure to industrial machinery, tools, and equipment, along with the operational procedures and safety practices in a manufacturing or engineering environment.

2047234274 2047237274	Industrial Training (SW)	540 Periods	C
PROJECT			12

- Offer insights into the daily operations and responsibilities of technicians, preparing students for the transition from academic settings to professional work environments.
- Educate students on industry standards, quality control measures, and best practices in mechanical engineering and manufacturing processes.
- Help students explore various career paths within mechanical engineering, enabling them to make informed decisions about their future professional goals.
- Provide opportunities for networking with industry professionals and potential employers.
- Encourage creative thinking and innovation by challenging students to solve real-world engineering problems and improve existing processes or products.
- Instill a sense of professionalism, work ethics, and responsibility required in the engineering field.

Course Outcomes

CO 1: Demonstrate proficiency in using industrial machinery, tools, and software.

CO 2: Able to identify, analyze, and solve engineering problems using industry-standard methods and practices.

CO 3: Gain a comprehensive understanding of industrial manufacturing processes, quality control, and safety practices.

CO 4: Exhibit improved communication, teamwork, and professional behavior in an industrial setting.

CO 5: Apply theoretical concepts learned in their coursework to practical engineering tasks and projects.

Duties Responsibilities of the Faculty Mentor.

Faculty mentors play a crucial role in overseeing and guiding students during their industrial training program in Diploma engineering.

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PROJECT			12

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.

Instructions to the students

Here are some instructions for Diploma engineering students undergoing industrial training during their academic duration:

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.

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PROJECT			12

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 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 reports 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. The details of the activity during the training will be monitored by the Faculty mentor through the faculty advisor and student.

The feedback shall be given to the HOD / Principal for further necessary action.

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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.

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PROJECT			12

Scheme of Evaluation

Internal Assessment

Students should be assessed for 40 Marks by industry supervisor and polytechnic faculty mentor during 3rd Month and 5th Month. The total marks (40 + 40) 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	Self expression / communication skills. Interpersonal skills / Human Relation.	10
D	Report and Presentation.	10
Total		40

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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 of six months. 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

2047237173	Mini Project (Sandwich Course Only)	L	T	P	C
PROJECT		0	0	4	2

Introduction

Every student must do one mini project in the sandwich diploma program. Students can do their 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.

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.

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PROJECT		0	0	4	2

- **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

CO 1: Demonstrate the ability to apply theoretical concepts and principles learned in coursework to solve practical engineering problems encountered during the project.

CO 2: Develop and enhance technical skills specific to the field of engineering relevant to the project, such as design, analysis, simulation, construction, testing, and implementation.

CO 3: Apply critical thinking and problem-solving skills to identify, analyze, and propose solutions to engineering challenges encountered throughout the project lifecycle.

CO 4: Acquire project management skills by effectively planning, organizing, and executing project tasks within defined timelines and resource constraints.

CO 5: 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 mini 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 project should be approved by the project monitoring committee constituted by the Chairman Board of Examinations.
- The project should be selected in the sixth semester itself. Each project shall have a maximum of four students in the project group.
- Provide comprehensive academic advising to help in the selection of appropriate 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.

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PROJECT		0	0	4	2

- 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.
- Ensure students have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of the 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 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.

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PROJECT		0	0	4	2

- 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 a project.

Submit a printed report of your project work along with the fabrication model / analysis report for the End Semester Examination.

Rubrics for Mini 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	Clear explanation of the research design.

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PROJECT		0	0	4	2

	Design and Methodology	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.

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PROJECT		0	0	4	2

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.

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.