Regulation 2023
Program Structure

1025 Diploma in Production Engineering

Program Outcomes (PO's)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability, attitude, and behavior that students acquire 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, asa 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	21
Semester IV	7	640	19
Semester V	8	635#	22
Semester VI	3	660	18
		Total	**120**

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

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1025 DIPLOMA IN PRODUCTION ENGINEERING (FT)

Semester I

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Humanities & Social Science	Theory	1000231110	Tamil Marabu	2-0-0	30	2	Theory
2	Basic Science	Theory	1000231230	Basic Mathematics	3-1-0	60	4	Theory
3	Basic Science	Practicum	1000231330	Basic Physics	2-0-2	60	3	Theory
4	Basic Science	Practicum	1000231430	Basic Chemistry	2-0-2	60	3	Theory
5	Engineering Science	Practical	1000231520	Digital Workplace Skills	0-0-4	60	2	Practical
6	Humanities & Social Science	Practicum	1000231640	Communicative English I	1-0-2	45	2	Practical
7	Engineering Science	Practicum	1000231740	Basic Workshop Practices	1-0-2	45	2	Practical
8	Open Elective	Advanced Skill Certification	1000231860	Basic English for Employability	0-0-4	60	2	Practical
9	Humanities & Social Science	Integrated Learning Experience	1000231880	Growth Lab	-	15	0	-
10	Audit Course	Integrated Learning Experience	1000231881	Induction Program - I	-	40	0	-
11	Audit Course	Integrated Learning Experience	1000231882	I&E/ Club Activity/ Community Initiatives	-	30	0	-
12	Audit Course	Integrated Learning Experience	1000231883	Shop Floor Immersion	-	8	0	-
13	Audit Course	Integrated Learning Experience	1000231884	Student-Led Initiative	-	22	0	-
14	Audit Course	Integrated Learning Experience	1000231886	Health & Wellness	-	30	0	-
					Test & Revisions	60		NA
					Library	15		
					Total	**640**	**20**	

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Semester II

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Humanities & Social Science	Theory	1000232110	Tamils and Technology	2-0-0	30	2	Theory
2	Program Core	Theory	1020232210	Basics of Mechanical Engineering	3-0-0	45	3	Theory
3	Engineering Science	Lab	1000232320	Drafting Practices	0-0-4	60	2	Practical
4	Basic Science	Practicum	1000232440	Applied Mathematics – I	1-0-4	75	3	Practical
5	Basic Science	Practicum	1000232540	Applied Physics – I	1-0-2	45	2	Practical
6	Basic Science	Practicum	1000232640	Applied Chemistry – I	1-0-2	45	2	Practical
7	Engineering Science	Practicum	1000232740	Basic Engineering Practices	1-0-2	45	2	Practical
8	Humanities & Social Science	Practicum	1000232840	Communicative English – II	1-0-2	45	2	Practical
9	Open Elective	Advanced Skill Certification	1000232860	Advanced Skills Certification - II	1-0-2	45	2	NA
10	Humanities & Social Science	Integrated Learning Experience	1000232880	Growth Lab	-	30	0	-
11	Audit Course	Integrated Learning Experience	1000232882	I&E/ Club Activity / Community Initiatives	-	30	0	-
12	Audit Course	Integrated Learning Experience	1000232883	Shop Floor Immersion	-	8	0	-
13	Audit Course	Integrated Learning Experience	1000232884	Student Led Initiative	-	24	0	-
14	Audit Course	Integrated Learning Experience	1000232885	Emerging Technology Seminars	-	8	0	-
15	Audit Course	Integrated Learning Experience	1000232886	Health & Wellness	-	30	0	-
					Test & Revisions	60		NA
					Library	15		
					Total	**640**	**20**	

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Semester III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1025233110	Production Technology	3-0-0	45	3	Theory
2	Program Core	Practicum	1020233230	Strength of Materials	3-0-2	75	4	Theory
3	Program Core	Practical/Lab	1020233320	Workshop Practices	0-0-4	60	2	Practical
4	Program Core	Practicum	1020233440	Industrial drives and control	1-0-4	75	3	Practical
5	Program Core	Practicum	1020233540	Production Drawing and Modeling	1-0-4	75	3	Practical
6	Program Core	Practicum	1025233640	Metrology and Metallography	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1025233760	Advanced Skills Certification - III	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	1025233880	Growth Lab	-	30	0	-
9	Audit Course	Integrated Learning Experience	1025233881	Induction Program - II	-	16	0	-
10	Audit Course	Integrated Learning Experience	1025233882	I&E/ Club Activity/ Community Initiatives	-	16	0	-
11	Audit Course	Integrated Learning Experience	1025233883	Shop floor Immersion	-	8	0	-
12	Audit Course	Integrated Learning Experience	1025233884	Student-Led Initiative	-	22	0	-
13	Audit Course	Integrated Learning Experience	1025233885	Emerging Technology Seminars	-	8	0	-
14	Audit Course	Integrated Learning Experience	1025233886	Health & Wellness	0-0-2	30	1	-
					Test & Revisions	30		NA
					Library	15		
					Total	**640**	**21**	

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Semester IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1020234110	Advanced Manufacturing Technology	3-0-0	45	3	Theory
2	Program Core	Practicum	1020234230	Fluid Mechanics	2-0-2	60	3	Theory
3	Program Core	Practical/Lab	1025234320	Metal Cutting, CNC Machines and 3D Printing	0-0-4	60	2	Practical
4	Program Core	Practicum	1025234440	Mechanical Instrumentation	1-0-4	75	3	Practical
5	Program Core	Practicum	1025234540	Thermal Engineering and Automobile Technology	1-0-4	75	3	Practical
6	Program Core	Practicum	1025234640	Applied Hydraulics and Pneumatics	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1025234760	Advanced Skills Certification - IV	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	1025234882	I&E/ Club Activity/ Community Initiatives	-	30	0	-
9	Audit Course	Integrated Learning Experience	1025234883	Shop floor Immersion	-	8	0	-
10	Audit Course	Integrated Learning Experience	1025234884	Student-Led Initiative	-	24	0	-
11	Audit Course	Integrated Learning Experience	1025234885	Emerging Technology Seminars	-	8	0	-
12	Audit Course	Integrated Learning Experience	1025234886	Health & Wellness	-	30	0	-
13	Audit Course	Integrated Learning Experience	1025234887	Special Interest Groups (Placement Training)	-	30	0	-
					Test & Revisions	30		
					Library	30		
					Total	**640**	**19**	

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Semester V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1020235110	Elements of Machine Design	3-0-0	45	3	Theory
2	Program Core	Practicum	1020235230	Industrial Engineering and Management	3-0-2	75	4	Theory
3	Program Elective	Practicum		Elective - I	2-0-2	60	3	Theory
4	Program Core	Practicum	1020235440	Maintenance, Repairs & Service	1-0-4	75	3	Practical
5	Program Elective	Practicum		Elective - II	1-0-4	75	3	Practical
6	Humanities & Social Science	Practicum	1020235654	Innovation & Startup	1-0-2	45	2	Project
7	Project/Internship	Project/Internship	1025235773	Industrial Training* [Summer Vacation - 90 Hours]	-	-	2	Project
8	Open Elective	Advanced Skill Certification	1025235860	Advanced Skills Certification - V	1-0-2	60	2	NA
9	Audit Course	Integrated Learning Experience	1025235981	Induction program - III	-	40	0	-
10	Audit Course	Integrated Learning Experience	1025235984	Student-Led Initiative	-	30	0	-
11	Audit Course	Integrated Learning Experience	1025235986	Health & Wellness	-	30	0	-
12	Audit Course	Integrated Learning Experience	1025235987	Special Interest Groups (Placement Training)	-	40	0	-
					Test & Revisions	45		
					Library	15		
					Total	**635**	**22**	

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Semester VI								
#	**Course Category**	**Course Type**	**Code**	**Course Title**	**L-T-P**	**Period**	**Credit**	**End Exam**
1	Open Elective	Theory		Electives - III (Pathway)	3-0-0	45	3	Theory
2	Open Elective	Practicum		Elective - IV (Specialisation)	1-0-4	75	3	Practical
3	Industrial Training / Project	Project/Internship		In-house Project / Internship /Fellowship **	-	540	12	Project
					Total	**660**	**18**	
3	Industrial Training / Project	Project/Internship	1025236351	Internship	-	540	12	Project
3	Industrial Training / Project	Project/Internship	1025236353	Fellowship	-	540	12	Project
3	Industrial Training / Project	Project/Internship	1025236374	In-house Project	-	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.

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Elective - I

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Practicum	1020235331	Modern QC Tools	2-0-2	60	3	Theory
2	Program Elective	Practicum	1020235332	Composite Materials	2-0-2	60	3	Theory
3	Program Elective	Practicum	1025235333	Process Planning and Cost Estimation	2-0-2	60	3	Theory
4	Program Elective	Practicum	1020235334	Value Engineering	2-0-2	60	3	Theory
5	Program Elective	Practicum	1020235335	Green Manufacturing	2-0-2	60	3	Theory
6	Program Elective	Practicum	1020235336	Lean Manufacturing	2-0-2	60	3	Theory
7	Program Elective	Practicum		Inter discipline course #	2-0-2	60	3	Theory

 # Courses from other programmes with the same credit can be considered after proper approval from the Chairman Board of Examinations.

Elective - II

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Practicum	1020235541	CNC Programming	1-0-4	75	3	Practical
2	Program Elective	Practicum	1020235542	Systems Applications and Product (SAP)	1-0-4	75	3	Practical
3	Program Elective	Practicum	1020235543	Industrial IoT	1-0-4	75	3	Practical
4	Program Elective	Practicum	1020235544	Advanced Welding Technologies	1-0-4	75	3	Practical
5	Program Elective	Practicum	1020235545	Industrial Robotics	1-0-4	75	3	Practical
6	Program Elective	Practicum	1025235546	Jigs, Fixtures and Press Tool Design	1-0-4	75	3	Practical
7	Program Elective	Practicum	1020235547	Automobile Technology	1-0-4	75	3	Practical

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Elective - III (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	1020236115	Industry 4.0	3-0-0	45	3	Theory
6	Elective | Technologists	Theory	1020236116	Additive Manufacturing	3-0-0	45	3	Theory
7	Elective | Technologists	Theory	1020236117	Power Plant Engineering	3-0-0	45	3	Theory
8	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.

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Elective - IV (Specialization)								
#	**Course Category**	**Course Type**	**Code**	**Course Title**	**L-T-P**	**Period**	**Credit**	**End Exam**
1	Elective	Practicum	1020236241	MEP Equipment Servicing	1-0-4	75	3	Practical
2	Elective	Practicum	1020236242	Maintenance of Machine Tools	1-0-4	75	3	Practical
3	Elective	Practicum	1020236243	Non-Destructive Testing	1-0-4	75	3	Practical
4	Elective	Practicum	1025236244	Production and Operations Management	1-0-4	75	3	Practical
5	Elective	Practicum	1020236245	Product Design & Development	1-0-4	75	3	Practical
6	Elective	Practicum	1020236246	Electric Vehicle Technology	1-0-4	75	3	Practical
7	Elective	Practicum	1020236247	Reverse Engineering	1-0-4	75	3	Practical
8	Elective	Practicum	1020236248	Green Energy & Engineering	1-0-4	75	3	Practical

1025233110	PRODUCTION TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Introduction

Production technology is a field that encompasses the techniques and methods used to manufacture products efficiently, consistently, and economically. This syllabus is designed to equip students with a deep understanding of the principles, tools, and practices involved in conventional as well as modern methods of manufacturing. This will provide the students an opportunity to skill themselves in various manufacturing techniques available in the industry. By engaging with this syllabus, students will develop a comprehensive understanding of production technology, preparing them for successful careers in manufacturing and industrial engineering.

Course Objectives

The objective of this course is to enable the student,

- To understand various casting processes, including pattern materials, moulding techniques, melting furnaces, and safety practices in the foundry environment.
- To explain the different types of welding techniques.
- To study the various types of bulk deformation processes, sheet metal forming techniques, and powder metallurgy.
- To learn the construction and operations of lathe, drilling machine and grinding machines.
- To study the construction and working of milling machine and reciprocating machines.

Course Outcomes

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

CO1: Discuss the various types of patterns, moulding process and casting techniques.

CO2: Explain the various welding techniques and welding defects.

CO3: Explain the various types of bulk deformation processes, sheet metal forming techniques, and powder metallurgy.

CO4: Describe the construction and operations of lathe, drilling machine and grinding machines.

CO5: Discuss the construction and working of milling machine and reciprocating machines.

Pre-requisites: Nil

1025233110	PRODUCTION TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping

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

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

Instructional Strategy

- Conduct group discussions on various types of machine tools.
- Encourage students to know about the latest technological developed in machine tools.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a 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

1025233110	**PRODUCTION TECHNOLOGY**	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test (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 Marks	15	15	05	20	60
Marks	15		05	20	60
Tentative Schedule	6th week	12th week	13-14th week	16th week	

CA1 and CA2: Assessment Written tests 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.

Answer 5 Questions (5 X 10 Marks = 50 Marks)

Eight questions will be asked, Students should write 5 questions. Each unit four questions can be asked. Each question may have subdivisions. Maximum two subdivisions shall be permitted.

1025233110	PRODUCTION TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

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.

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	**FOUNDRY TECHNOLOGY**	
Chapter1.1: Foundry: Pattern – pattern materials – types – single piece (solid), split type, loose piece and match plate only – allowances – moulding – mould boxes – moulding sand – properties – core – CO_2 core making. Melting Furnaces – cupola furnace – crucible furnace – electric arc furnaces. Chapter1.2: Casting Processes: Sand casting using green sand and dry sand – gravity die casting – pressure die casting – hot and cold chamber processes – centrifugal casting – continuous casting – defects in casting – causes and remedies - safety practices in foundry.		9

1025233110	PRODUCTION TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Unit II	WELDING TECHNOLOGY	
Chapter 2.1: Basic Welding Processes: Arc welding – definition – arc welding equipment – arc welding methods – carbon arc, metal arc, metal inert gas (MIG), tungsten inert gas (TIG). Gas Welding – gas welding equipment – oxy-acetylene welding – three types of flame. Chapter 2.2: Special Welding Processes: Resistance welding – principle – classification of resistance welding – spot – seam – projection – butt welding – plasma arc welding – laser beam welding – electron beam welding – soldering and brazing - defects in welding - causes and remedies -safety practices in welding.		9
Unit III	**METAL FORMING PROCESSES AND POWDER METALLURGY**	
Chapter 3.1: Bulk Deformation Processes: Difference between hot working and cold working – forging – types – drop forging, press forging, upset forging – rolling – classification of rolling mills – extrusion – direct and indirect extrusion. Chapter 3.2: Sheet Metal Forming: Bending operations – shearing operations – blanking – piercing – trimming – notching – lancing – shaving – parting off. Chapter 3.3: Powder Metallurgy (PM): Methods of manufacturing metal powders– atomization, reduction and electrolytic deposition – blending – compacting – sintering – infiltration.		9
Unit IV	**MACHINING TECHNOLOGY – LATHE, DRILLING MACHINE & GRINDING MACHINES**	
Chapter 4.1: Lathe: Construction – simple sketch with principal parts – work holding devices – three & four jaw chuck, catch plate and carrier, center – lathe operations – facing, straight turning, step turning, taper turning, knurling, thread cutting, boring.		

Chapter 4.2: Drilling Machine: Radial drilling machine – construction – drilling operations – reaming, counter boring, counter sinking, spot facing, tapping. Chapter 4.3: Grinding Machines: Cylindrical grinder – centerless grinder – surface grinder – standard marking systems of grinding wheels – dressing and truing of grinding wheels.		9
UNIT V	**MACHINING TECHNOLOGY – MILLING MACHINE & RECIPROCATING MACHINES**	
Chapter 5.1: Milling Machine: Universal milling machine – construction and working – tool holding devices – arbor – stub arbor – spring collet – adaptor – milling operations – plain milling, face milling, end milling, straddle milling, gang milling – indexing plate – simple indexing and differential indexing. Chapter 5.2: Reciprocating Machines: Construction and working of standard shaper – construction and working of double housing planer – construction and working of horizontal broaching machine – pull broach and push broach.		9
	TOTAL HOURS	45
	Assessment Test and Revision with Student activity	15*

***Common Test and Revision periods can be used. 1 Period per week can be used for this subject.**

Suggested list of Students Activity,

1. Prepare a green sand mould for the solid and split patterns.
2. Practice the basic welding operations.
3. Practice the bending and shearing operations in the press.
4. Practice the basic lathe, drilling and grinding operations.
5. Practice the basic milling and shaping operations.

1025233110	PRODUCTION TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Reference Books:

1. Elements of workshop Technology Volume I&II – Hajra Chowdry & Bhattacharaya - IIth Edition - Media Promoters & Publishers Pvt. Ltd.,
2. A Text book 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.
5. Workshop Technology – Raghuwanshi – Khanna Publishers. Jain & Gupta.
6. Production Technology, Edn.XII, Khanna Publishers.
7. Production Technology - P.C.SHARMA- Edn.X - S.Chand & Co. Ltd., Ram nagar, New Delhi 110 055 - 2006.
8. Production Technology – HMT - Edn.18 - published by Tata McGraw Hill publishing Co. Ltd., 7 West Patel nagar, New Delhi 110 008 – 2018.
9. Manufacturing Engineering & Technology – Serope Kalpakjian & Steven R. Schmid – 8th Edition, Pearson Publishing Company, Upper Saddle River, New Jersey - 2020.

Web Reference

1. https://youtu.be/vpIwhrVJ9Co
2. https://youtu.be/ocBSw_Je6WU
3. https://youtu.be/dkrqAvqDLUY
4. https://youtu.be/RWCEgNCfFSI
5. https://youtu.be/DJ5Z6cWWJaE
6. https://youtu.be/twUAa5LWUvk
7. https://youtu.be/uO5pVLOAmD4

1025233110	**PRODUCTION TECHNOLOGY**	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.

1020233230	**STRENGTH OF MATERIALS**	L	T	P	C
PRACTICUM		3	0	2	4

Introduction:

Strength of materials is a key subject in mechanical 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

Towards developing the theoretical basics about the stress, strain and elastic modulus concepts in various components.

Understand the mechanical behavior of materials.

To solve practical problems related to shafts and springs.

Estimate the stresses induced in thin cylinders.

Understand the basics of engineering materials and their role in the development of societies and industries.

Course Outcomes:

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

CO1: Discuss various engineering materials and their mechanical propertiesCO2:

Compute the effects various loads on materials

CO3: Analyse the shaft using the principles of pure torsionCO4:

Analyse the springs in various load conditions

CO5: Determine the various dimensions of thin cylinders under various load conditions

Pre-requisites:

Knowledge of basic mathematics and Science

1020233230	STRENGTH OF MATERIALS	L	T	P	C
PRACTICUM		3	0	2	4

CO/PO Mapping

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

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

Instructional Strategy:

The instructional strategy for teaching strength of materials in polytechnic colleges emphasizes practical application and industry relevance.

Through a curriculum aligned with the state technical education board, the syllabus is broken down into manageable units, prioritizing topics pertinent to Indian engineering contexts.

Visual aids, bilingual explanations, and hands-on demonstrations are utilized to accommodate linguistic diversity and enhance understanding.

Incorporating industry examples and field visit to construction sites and manufacturing facilities fosters experiential learning.

Assessment methods include practical assessment, written exams, and peer learning initiatives, complemented by career guidance to inform students about opportunities in mechanical engineering.

Continuous feedback mechanisms ensure the refinement and effectiveness of the instructional approach.

1020233230	**STRENGTH OF MATERIALS**	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 Periods	2 Periods	3 Hours	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.
  Answer any 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. Maximumtwo 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 experiment by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks will be converted to 15 Marks for the internal mark.

1020233230	STRENGTH OF MATERIALS	L	T	P	C
PRACTICUM		3	0	2	4

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 practical documents to be prepared as per the instruction below.

Each exercise observation and calculations 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 printed manual or file. The reading and calculations and graph should be written by the student manually. The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Apparatus required	10
B	Procedure / Observation	20
C	Formula / Calculation	20
D	Result / Graph	10
E	Practical document (All Practicals)	30
F	Viva Voce	10
Total		100

1020233230	**STRENGTH OF MATERIALS**	L	T	P	C
PRACTICUM		3	0	2	4

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.

Syllabus Contents

Unit I	**SELECTION OF MATERIALS**
Theory: **Engineering materials:** Introduction to engineering materials- Ferrous and Non Ferrous materials - material selection-factors affecting the selection of materials-procedure for materials selection. Advanced materials - smart materials and nanomaterials-classification of nanomaterials – applications. **Hardness test:** Brinell hardness test, Rockwell hardness test, Vickers Hardness test – Shore Hardness Test (Durometer) - Knowledge on Micro Hardness test	9
Practical: **EXPERIMENT : 1.** **Hardness Test:** Determination of Rockwell hardness number for various materials like mild steel, high carbon steel, brass, copper, aluminium and Plastics (Any Two Materials).	3

1020233230	**STRENGTH OF MATERIALS**	L	T	P	C
PRACTICUM		3	0	2	4

Unit II	**DEFORMATION OF METALS**	
Theory: **Simple stresses and strains:** Definition - load, stress and strain - classification of force systems - tensile, compressive and shear force systems– Definition - Hooke'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. **Mechanical testing of materials:** Tensile test of mild steel in UTM - stress strain diagram - limit of proportionality - elastic limit -yield stress - breaking stress - ultimate stress - percentage of an elongation and percentage reduction in area (no problems)- fatigue test - creep test.		9
Practical: **EXPERIMENT : 2.** **Tensile Test on materials :** Determine young's modulus of elasticity, yield stress, ultimate stress, breaking stress, percentage of elongation and percentage of reduction in area of a given specimen (Mild steel, Cast Iron , Aluminium, Brass) (Any one material) and plot stress strain diagram.		4
Unit III	**ELASTIC CONSTANTS AND STRAIN ENERGY**	
Theory: **Elastic constants:** Definition - lateral strain – poison's ratio - volumetric strain - bulk modulus - volumetric strain of rectangular and circular bars (No derivation) - problems connecting linear, lateral and volumetric deformation – Simple problems on elastic constants. **Strain energy:** Definition - proof resilience - modulus of resilience - the expression for strain energy stored in a bar due to axial load - instantaneous stresses due to sudden and impact loads (No derivation) - problems computing instantaneous stress and deformation in sudden and impact loadings.		9

1020233230	STRENGTH OF MATERIALS	L	T	P	C
PRACTICUM		3	0	2	4

Practical: **EXPERIMENT : 3.** Impact test : Find the impact strength of the given specimen (Mild steel, Cast Iron, Aluminium and Brass) (Any Two materials) using izod test and Charpy test.		3
Unit IV	**THEORY OF TORSION**	
Theory: **Torsion:** Theory of torsion - assumptions - torsion equation $\frac{T}{J}=\frac{f_s}{R}=\frac{C\theta}{l}$ (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. **Material testing:** Torsion testing machine (Description only).		9
Practical: **EXPERIMENT : 4.** **Torsion test:** Determine the shear stress and modulus of rigidity of the given specimen (Mild steel, Cast Iron, Aluminium and Brass) (Any two materials) using a Torsion testing machine.		4
Unit V	**SPRINGS AND THIN CYLINDERS**	
Theory: **Springs:** Types of springs - laminated and coiled spring - applications - types of coiled springs - difference between open and closely coiled helical springs - closelycoiled helical spring subjected to an axial load (no derivation) - problems to determine shear stress, deflection, stiffness and resilience of closed coil helical springs.		9

1020233230	**STRENGTH OF MATERIALS**	L	T	P	C
PRACTICUM		3	0	2	4

Thin cylinders: Definition - thin cylindrical shell - failure of thin cylindrical shell subjected to internal pressure - hoop and longitudinal stresses causes in thin cylindrical shell subjected to internal pressure (no derivation) - simple problems - change in dimensions of a thin cylindrical shell subjected to internal pressure - problems	
Practical: **EXPERIMENT : 5.** **Test on springs of circular section:** Determine the modulus of rigidity and strain energy, and stiffness of the open coiled helical springs. **EXPERIMENT : 6.** Determine the modulus of rigidity and strain energy, and stiffness of the closed coiled helical springs.	6
Revision + Test + Students Activity	10
TOTAL HOURS	75

Suggested List of Students Activity:

Other than the classroom learning , the following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course.

- Conduct a survey, specific to properties of various types of materials used in mechanical engineering and prepare a report.
- Compare the strength of the solid shaft with that of hollow shaft for the same power transmission for an automobile and make a report.
- Students can be given practices in the Virtual Labs | Mechanical Engineering (vlab.co.in). This can be given to a team of students and make them prepare a report.

1020233230	**STRENGTH OF MATERIALS**	L	T	P	C
PRACTICUM		3	0	2	4

Sample Experiments: Four bar mechanism, Slider crank mechanism, Elliptical Trammel, Cam Mechanism, Linkage Model, Crank and Slotted Mechanism, Whitworth Mechanism, Straight Line Mechanism, Universal Joint etc..

Text and Reference books:

1. Dr. P.Purushothama Raj, V. Ramasamy, Strength of Materials, Pearson Edition 2013.
2. Dr. R K Bansal, strength of materials, 5th edition , Laxmi publications private limited,2013.
3. R S Khurmi , strength of materials, edition 2019 , S Chand publications, 2019.
4. B K Sarkar, strength of materials, 10th edition, tata McGraw hill education private limited, 2012.
5. R K Rajput, materials science and engineering, 5th edition, S K Kataria and sons publications, 2024

Web reference:

- https://youtu.be/GkFgysZC4Vc?si=j-q-9UMmeDg64YNB
- https://youtu.be/uA_HqCGo8Pg?si=q03sPw7010ot0BdT
- https://youtu.be/WERoSRcnafA?si=b7Xv3RI1s8LvSUhw

Equipment / Facilities required to conduct the Practical Portions.

1. Universal testing machine.	01
2. Rockwell's hardness testing machine.	01
3. Impact testing machine.	01
4. Torsion testing machine.	01
5. Spring testing machine	01

Required instruments and consumables.

1020233230	**STRENGTH OF MATERIALS**	L	T	P	C
PRACTICUM		3	0	2	4

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.

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

Introduction:

Diploma technocrats frequently encounter diverse manufacturing processes. This course workshop practice aims to enhance student's comprehension of manufacturing methods, like Welding, Soldering, Brazing and use of Power tools.

Course Objectives:

- To identify the tools and equipment used in workshop practice.
- Perform welding operations to make different types of joints.
- Identify the different welding defects.
- Practical skills on Soldering, Brazing and power tools.
- Prepare a record of work for all the exercises.

Course Outcomes:

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

CO1: Recall the safety procedure followed on the shop floor.

CO2: Demonstrate skills in all types of welding.

CO3: Acquire skills on soldering.

CO4: Acquire skills on Brazing.

CO5: Demonstrate skills on the use of Power tools.

Pre-requisites:

Basic Workshop Practices and Basic Engineering Practices.

1020233320	WORKSHOP PRACTICES	L	T	P	C
PRACTICAL		0	0	4	2

CO/PO Mapping

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

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle	Second Cycle	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 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.
  Cycle I: 1, 2, 3, 4 and 5.
  Cycle II: 6, 7, 8, 9 and 10.

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Tools required	10
B	Preparation	20
C	Welding / Cutting/ Joining	20
TOTAL		**50**

- **CA 3:** Practical document 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 printed manual or in a file with the documents. The procedure and sketch should be written by the student manually.

  The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.
- **CA 4:** All the exercises 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 (CA4) should be conducted as per the scheme of evaluation as below. The marks awarded should be converted to 20 Marks for the internal assessment.

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Tools required	10
B	Procedure	20
C	Preparation	20
D	Welding / Cutting/ Joining	20
E	Accuracy / Tool Handling / Finish / Result	20
F	Viva Voce	10
	TOTAL MARKS	**100**

Syllabus Contents

Introduction	**Period**
BUREAU OF INDIAN STANDARDS CODE OF PRACTICE FOR SAFETY AND HEALTH REQUIREMENTS IN ELECTRIC AND GAS WELDING AND CUTTING OPERATIONS – IS : 818 - 1968 Fire prevention and protection-Protection of personnel - general and protective equipment- Work in confined spaces - ventilation and health protection. Soldering - Basic principles – Brazing – Basic principles.	

Practical Exercises **40 Periods**

1. Lap joint Arc Welding (RawMaterial: 40 mm x 10 mm MS flat)
2. T- Joint - Arc Welding (RawMaterial: 40 mm x 10 mm MS flat)
3. Butt Joint (TIG / MIG Welding) (RawMaterial: MS Pipe / MS Square tube)
4. Profile cutting – circular profile - Gas cutting. (Raw Material: 100 x 100 mm X 6mm M.S.Flat)

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

5. Lap joint - Gas Welding - (Raw Material: 10G Mild Steel)
6. Spot welding - Lap joint - Make a tray and join the vulnerable points (Minimum 8 Points) (Raw Material: GI/MS Sheet 22 G).
7. Solder as per the given circuit diagram.
8. Braze the joints of the copper tube. Prepare the tube with Cutting, bending, flaring, Swaging and pinching practice.
9. Dismantle and Assemble the Bolt/Nut using wrench power tools. (Pneumatic / Electric). (Sample Exercise Flange / Cylinder head / Remove Tire from the disc / etc…)
10. Profile cutting – Using Jigsaw/Craftsman cutter/Reciprocating cutter. (Raw Material: 100 x 100 mm X 6 mm M.S.Flat / Wood)

Test & Revision **10 Periods**

Suggested List of Students Activity: **10 Periods**

1. Study the welding symbols and welding testing procedure.
2. List Causes of welding defects and suggest remedies.
3. Practices in Soldering and Brazing. Compare the soldering and brazing process.
4. Enumerate safety guidelines and precautions for a welding shop.
5. Inspect the assembly lines in an Industry and submit a report.

Text and Reference Books:

1. Manufacturing Technology Vol-1 by P N RAO, McGraw Hill, New Delhi.
2. Manufacturing Technology Vol-2 by P N RAO, McGraw Hill, New Delhi.
3. Elements of Workshop Technology Vol-1 by S K Hajra Choudhury, A K Hajra Choudhury, Nirjhar Roy-Media Promoters & Publisher PVT. Ltd.
4. CODE OF PRACTICE FOR SAFETY AND HEALTH REQUIREMENTS IN ELECTRIC AND GAS WELDING AND CUTTING OPERATIONS (First Revision) IS : 818 – 1968- Seventh Reprint SEPTEMBER 1998

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

Web-based/Online Resources:

1. https://www.youtube.com/watch?v=RyLvVMg84xs -Basics of welding process2.
2. https://www.youtube.com/watch?v=nBwRpI_0d50 - Fundamentals of Brazing3.
3. ttps://www.youtube.com/watch?v=Wbd0mhOfGRg - Soldering Basics

END SEMESTER EXAMINATION – PRACTICAL EXAM.

BOARD EXAMINATIONS

Note:

- All the exercises have to be completed, any one exercise will be given for examination.
- All the exercises should be given in the question paper. The student is allowed to select by lot or question papers issued by the DOTE Exam section shall be used.
- Practical documents along with the activity report should be submitted for the End Semester Examinations.

DETAILED ALLOCATION OF MARKS.

Part	Description	Marks
A	Aim & Tools required	10
B	Procedure	20
C	Preparation	20
D	Welding / Cutting/ Joining	20
E	Accuracy / Tool Handling / Finish / Result	20
F	Viva Voce	10
	TOTAL MARKS	**100**

1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

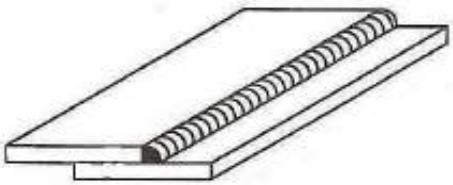
Equipment / Facilities required conducting the Practical Course.

S.No	Name of the Equipment's	Quantity Required
1.	Arc welding booth	2 Nos with welding transformer
2.	TIG / MIG welding booth	1 No
3.	Gas welding unit	1 Set (Oxygen and acetylene cylinder)
4.	Welding shield	5Nos
5.	Gas welding goggles	5Nos
6.	Chipping hammer	5Nos
7.	Leather Gloves 18"	5 Sets
8.	Spot welding machine	1 No
9.	Brazing equipment	1 No
10.	Soldering equipment	1 No
11.	Electric Jig saw / Craftsman cutter / Reciprocating cutter	1 No
12.	Pneumatic / Electric impact wrench	1 No
13.	Cutting, bending, flaring, Swaging and pinching tool for copper tube	Each 1No
14.	Consumables	Sufficient quantity

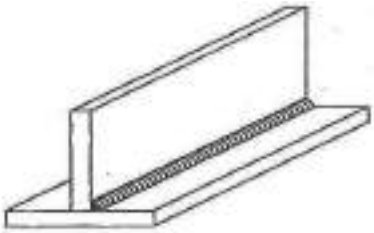
1020233320	**WORKSHOP PRACTICES**	L	T	P	C
PRACTICAL		0	0	4	2

Exercises drawing:

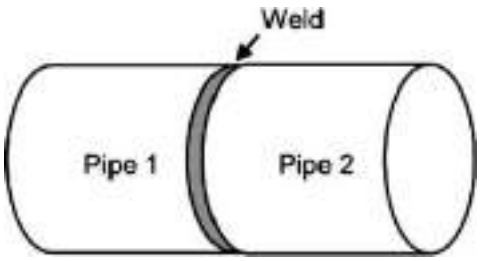
1. Lap Joint - Arc Welding (Raw Material: 40 mm X 10 mm MS flat)



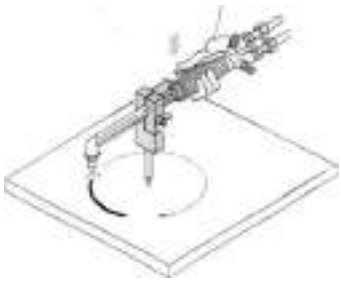
2. T-Joint -Arc Welding (RawMaterial:40 mm X 10 mm MS flat)



3. Butt Joint-TIG / MIG Welding (Raw Material: MS Pipe / MS Square tube)

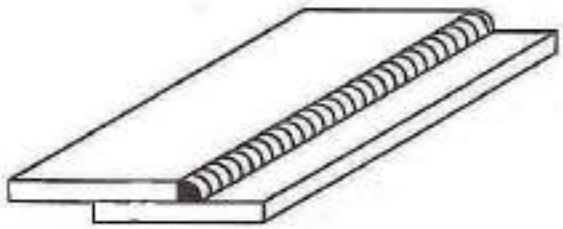


4. Profile cutting- Circular profile -cutting Gas cutting
(Raw Material : 100 x 100mm x 6mm M.S. flat)

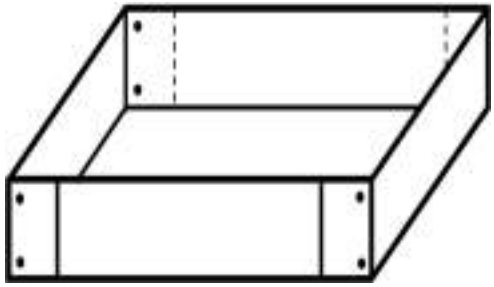


1020233320	WORKSHOP PRACTICES	L	T	P	C
PRACTICAL		0	0	4	2

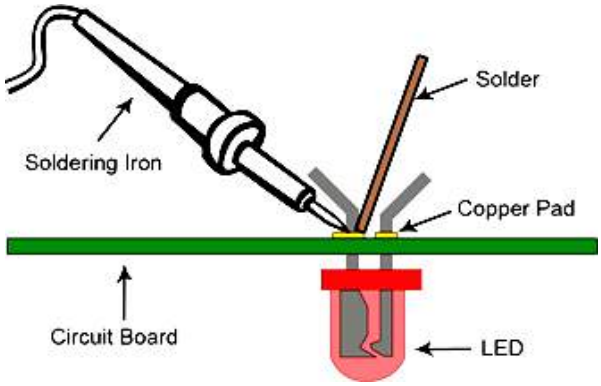
5. Lap joint - Gas Welding- (Raw Material: 10G Mild Steel)



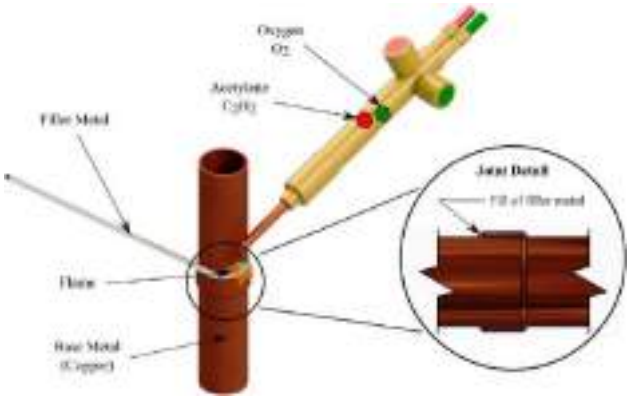
6. Spot welding - Lap joint - Make a tray / dustpan and join the vulnerable points (Minimum8 Points) (Raw Material: GI/MS Sheet 22 G)



7. Solder as per the given circuit diagram / Battery pack with series and parallel connections.



8. Braze the joints of the copper tube. Prepare the tube with Cutting, bending, flaring, Swaging and pinching practice.



Cutting, bending, flaring, Swaging and pinching practice using copper tube.





9. Dismantle and Assemble the Bolt/Nut using wrench power tools. (Pneumatic / Electric).
(Sample Exercise Flange / Cylinder head / Remove Tire from the vehicle disc / etc…)


1020233320	WORKSHOP PRACTICES	L	T	P	C
PRACTICAL		0	0	4	2

10. Profile cutting – Using Jigsaw. (Raw Material: 100 x 100 mm X 6 mm M.S.Flat / Wood)

Text and Reference Books:

1. CODE OF PRACTICE FOR SAFETY AND HEALTH REQUIREMENTS IN ELECTRIC AND GAS WELDING AND CUTTING OPERATIONS (First Revision) IS : 818 – 1968 - Seventh Reprint SEPTEMBER 1998.
2. Hajra Choudry & Battacharya - Elements of Workshop Technology - Vol. I & II -Edition 11, - Media Promoters and Publishers Pvt. Ltd.,– 2007.
3. P N RAO-Manufacturing technology - 5th edition - McGraw Hill, New Delhi.2018.

Web-based Online Resources:

- https://www.youtube.com/watch?v=dMcP3aCHyTQ Welding Processes – NPTEL-NOC IITM
- https://www.youtube.com/watch?v=TpvmJBeGUrg&list=PLyqSpQzTE6M-KwjFQByBvRx464XpCgOEC&index=2 Classification of welding processes and definition of welding arc - NEPTE - NOC IITM.

1020233440	**INDUSTRIAL DRIVES AND CONTROL**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Motion control is required in a large number of industrial and domestic applications. Systems employed for getting the required motion and their smooth control are called Drives. Drives require prime movers like Diesel or petrol engines, gas or steam turbines, hydraulic motors or electric motors. These prime movers deliver the required mechanical energy for getting the motion and its control. Drives employing Electric motors as prime movers for motion control are called Electric Drives. Further electrical speed control in almost all industrial applications are incomplete without the use of the specific electric drive. This course will empower the students with the necessary skills to understand the concept associated with Electrical Drives.

Course Objectives:

The objective of this course is to enable the student to

- Explain the necessity of A.C Circuit, Fuse, MCB, ELCB and Contactor.
- Explain the Working of RPS, Logic Gates and PLC.
- Define electric drive, its parts, advantages and explain choice of electric drive.
- Understand the characteristics of DC Shunt Motor and 3 Phase Induction Motor.
- Discuss the concept of AC Drive, Stepper Motor Drive and Servo Motor Drive.

Course Outcomes:

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

CO1: Demonstrate the working of MCB, ELCB and Contactor.

CO2: Describe the working of RPS and Simple LED Circuit.

CO3: Describe the concept of Logic Gate and PLC.

CO4: Demonstrate the starting and speed control methods of Induction Motor.

CO5: Interface and test the working of Driver for DC Motor and Stepper Motor.

Pre-requisites:

Basics of Science and Engineering

1020233440	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping:

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their 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 usedto ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as faras possible.

1020233440	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 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 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.

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 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 logbook 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	5
B	Circuit Diagram	20
C	Connections and Execution	25
TOTAL		50
D	Practical Documents (As per the portions)	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.

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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

- **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. 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	5
B	Circuit Diagram	20
C	Connections and Execution	25
D	Output / 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.

1020233440	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Syllabus Contents.

Theory Portion : UNIT I	
A.C CIRCUITS	Period
Review of Ohm's Law – Review of Series and Parallel Connection – Fundamentalsof AC Voltage and Current - Peak Value, Average Value, RMS value of Sine wave – Frequency - Time period – Amplitude - Power and Power Factor – Current calculation by using single phase power formula – Introduction about Three phaseac supply - Current calculation by using three phase power formula - Necessity of Contactor - Solenoid type Contactor - Necessity of Fuse – Function of MCB – Function of ELCB.	4
ANALOG AND DIGITAL ELECTRONICS	
Name, Symbol and uses of Semiconductor Devices (Diode, Transistor, LED and SCR) – Importance of current limiting resistor in LED circuit – RGB LED - Working ofHalf wave and Full wave rectifiers - Block Diagram of Regulated Power Supply. Logic gates: Binary Number System - Positive and Negative Logic - Definition, Symbol, Truth table and Boolean expression for OR, AND, NOT, NOR, NAND, EX-OR and EX-NOR gates - Universal Logic Gates: NAND and NOR. Programmable Logic Controller: Definition - Block Diagram of Programmable Logic Controller – PLC Scan – Ladder Logic for AND Gate and OR Gate.	4
Practical Exercises:	

Ex.No	**Name of the Experiment**	**Period**
1.	VOLTAGE, CURRENT AND POWER MEASUREMENT IN SINGLE PHASE AC CIRCUIT. Activities to Perform: a) Conduct an experiment to measure voltage, current and power in a single phase a.c circuit by using Voltmeter, Ammeter and Wattmeter respectively for different loads.	4

	b) Repeat the same experiment by replacing above meters with a single Digital Power Monitor. c) Compare and Discuss the observations.	
2.	CONSTRUCT LED CIRCUIT WITH CURRENT LIMITING RESISTOR Activities to Perform: a) From the voltage and current rating of the given LED, calculate the value of the resistor to be connected in series with it. b) Construct and test a simple circuit using DC Source, Resistor and LED. c) Construct and test a simple circuit using DC Source, Resistor and RGB LED.	4
3.	CONSTRUCT DC REGULATED POWER SUPPLY UNIT Activities to Perform: a) Construct 5V or 12V DC Regulated Power Supply circuit using Bridge Rectifier, Capacitor Filter and IC Voltage Regulator. b) Observe the voltage at various stages of the circuit. c) Discuss the function of each stage of the RPS unit.	4
4.	DEMONSTRATE THE WORKING OF MCB AND ELCB Activities to Perform: a) Connect Single Pole MCB with Load bank and Test the Tripping Operation for overload and/or Short Circuit fault. b) Connect ELCB with Lamp Load and Test the Tripping Operation for Earth fault.	4
5.	LOGIC GATE USING ICs Activities to Perform: a) Construct the circuit and verify the Truth Tables of AND, OR, NOT, NAND, NOR, EX-OR Logic gates by using corresponding Logic Gate ICs. b) Compare and Discuss the observations.	4

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PRACTICUM		1	0	4	3

Theory Portion : UNIT II	
ELECTRIC DRIVES	
Introduction – Need for Drive – Advantages of Electric Drive – Parts of Electric Drive – Classification of Drives (Group Drive, Individual Drive and Multimotor Drive) – Classification of Electric Motors - Characteristics of DC Shunt Motor and DC Series Motor – Necessity of starters - Three point starter. Construction, Working Principle and Characteristics of Three Phase squirrel cage induction motor – DOL Starter – Star Delta Starter - Effect of Unbalanced source voltage and Single Phasing – Methods of Speed control of three phase induction motor - Block diagram of Variable Frequency Drive (VFD) - Electric Braking – Typesof Electrical Braking – Selection of Motors for different applications – Motors usedfor Traction system. Overview of PMDC Motor, BLDC Motor, Stepper Motor Drive, Servo Motor Drive – L293D Motor Driver IC.	7

Practical Exercises:

Ex.No	**Name of the Experiment**	**Period**
6.	LOAD TEST ON DC SHUNT MOTOR Activity to Perform: a) Conduct Load Test on given DC Shunt Motor b) Discuss the starting current and No load current of the Motor c) Plot the performance Characteristics.	4
7.	LOAD TEST ON THREE PHASE INDUCTION MOTOR Activity to Perform: a) Conduct Load Test on given three phase squirrel cage Induction Motor. b) Discuss the starting current and No load current of the Motor c) Plot the performance Characteristics.	4

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PRACTICUM		1	0	4	3

8.	SPEED CONTROL OF INDUCTION MOTOR USING VFD Activity to Perform: a) Make connections and Control the speed of the given singlephase or three phase squirrel cage induction motor by VFD. b) Discuss the features and advantages of VFD.	4
9.	DIRECTION CONTROL OF DC MOTOR USING DRIVER IC L293D Activity to Perform: a) Interface L293D Motor Driver IC with Arduino to control Direction of rotation of Two DC Motors. b) Execute the Arduino program and observe the direction of rotation of Motors.	4
10.	TESTING OF STEPPER MOTOR DRIVE Activity to Perform: a) Interface suitable stepper motor driver with stepper motor. b) Test the operation of the driver circuit by observing the movement of the stepper motor.	4
	Assessment Test + Revision + Students Activity	20
	Total	**75**

Suggested List of Students Activity:

Activity 1: Study and understand the construction and working of DC Generator, Transformer and Alternators available in the Laboratory. Then each student shall write and submit the Report on the above topics.

Activity 2: Four students can be grouped as a batch to collect information about Industrial applications of various types of Electric Motors and submit as activity report. Reference books / website details/ Visited Industry details for collection of above information must be mentioned in the report itself.

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PRACTICUM		1	0	4	3

Text book for Reference:

1. B. L. Theraja and A. K. Theraja, A Textbook of Electrical Technology Volume - II (AC and DC Machines), Multicolour Edition, S. Chand & Co., 2005.
2. V K Mehta, Rohit Mehta, Principles of Electronics, 12 th Edition, S. Chand & Co., 2020.
3. B.N. Sarkar, Fundamentals of Industrial Drives, 1 st Edition, PHI Learning Pvt. Ltd., 2012.
4. Frank D. Petruzella, Programmable Logic Controllers, 6 th Edition, Indian Edition, Mc Graw Hill, 2023.

Web-based/Online Resources:

- https://nptel.ac.in/courses/108/104/108104140/#
- https://archive.nptel.ac.in/courses/108/105/108105155/
- https://archive.nptel.ac.in/courses/108/105/108105158/
- https://archive.nptel.ac.in/courses/108/105/108105132/

1020233440	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

Equipment / Facilities required to conduct the Practical Course.

S.No	Name of the Equipment's	Quantity Required
1.	MI Ammeter 0-5A, MI Voltmeter 0- 300V, ED Wattmeter 300V/5A, Digital Power Monitor, Lamp Load.	Each 1 No.
2.	5V/12V DC Power Supply Unit, LED, RGB LED and Resistors.	Each 1 No.
3.	230V/12V Transformer, Diodes, Filter Capacitor, Voltage Regulator IC, Resistors and CRO.	Each 1 No.
4.	3 Amps MCB and 30mA ELCB.	Each 1 No.
5.	5V RPS, Logic Gate ICs: 7408, 7432, 7404, 7400, 7402 & 7486, Toggle Switches, LEDs and Resistors.	Each 5 Nos.
6.	DC Shunt Motor with Starting and Loading arrangements.	1 No.
7.	Contactor and NO, NC Push buttons.	Each 1 No.
8.	3 Phase Squirrel Cage Induction Motor with Starting and Loading arrangements.	1 No.
9.	Variable Frequency Drive.	1 No.
10.	DC Motor, L293D Motor Driver IC and Arduino Shield.	1 No.
11.	Stepper Motor with Driver Shield.	1 No.
12.	Suitable range of MC Voltmeter and Ammeter for DC Motor.	Each 1 No.
13.	Suitable range of MI Voltmeter and Ammeter for AC Motor.	Each 1 No.
14.	Tachometer.	1 No.
15.	Digital Multimeter.	4 Nos.

Note:

- Sufficient number of Worktables to be provided in the laboratory to conduct experiments for students.

1020233440	INDUSTRIAL DRIVES AND CONTROL	L	T	P	C
PRACTICUM		1	0	4	3

- Ensure Permanent wiring connections with suitable circuit breakers / Protective mechanism in the Worktables with proper safety measures.
- In addition to the above list sufficient quantities of consumable, Tools and Testing Instruments to be maintained.
- Charts on Electrical Safety and Procedure of First Aid to be displayed in the Laboratory.
- Necessary proper electrical safety arrangements should be done in the laboratory.
- Awareness about the First Aid for Electrical accidents should be given.

END SEMESTER EXAMINATIONS – 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	5
B	Circuit Diagram	20
C	Connections / Execution	25
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.

1020233540	PRODUCTION DRAWING & MODELLING	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Production Drawing & Modelling is a crucial aspect of design and manufacturing processes. It involves creating detailed technical drawings and three-dimensional models to communicate product specifications and aid in production. This discipline ensures precision, efficiency and consistency in manufacturing various products across industries in engineering and product design.

Course Objectives:

- Understand fundamental principles: Learn the foundational concepts, principles, and standards of production drawing and modelling, including geometric dimensioning and tolerance (GD&T), drafting conventions, and industry-specific guidelines.
- Develop technical drawing skills: Acquire proficiency in creating accurate and detailed technical drawings using CAD software, focusing on orthographic projections, isometric views, section views, and assembly drawings.
- Master 3D modelling techniques: Gain expertise in constructing three-dimensional models of objects and components using CAD software, emphasise solid modelling, surface modelling, parametric modelling, and assembly modelling.
- Interpret engineering documentation: Learn to interpret and analyse engineering drawings, specifications, and other technical documents to extract relevant information for manufacturing processes, including material specifications, geometric tolerances, and assembly instructions.

Course Outcomes:

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

CO1: Draw various sectional views of 2D assembly drawings manually as per BIS.

CO2: Create sectional views for 2D assembly drawing.

CO3: Create 3D modelling using CAD software module.

CO4: Interpret the drawing and symbols in the Engineering field.

CO5: Demonstrate proficiency in 3D modelling by creating and assembling machine components.

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites:

DRAFTING PRACTICES

CO/PO Mapping

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

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

Instructional Strategy:

- Utilise a blended approach with lectures on manual drawing fundamentals and CAD software introduction.
- Incorporate hands-on sessions for manual drawing practice and CAD software usage.
- Assignments focus on creating detailed drawings of machine parts, transitioning to CAD for 3D modelling, assembly, and printing components.
- Encourage peer collaboration and feedback.

1020233540	**PRODUCTION DRAWING & MODELLING**	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	Drafting Practices and Solid modelling Practices (Ex 1 and 2)	Drafting Practices and Solid modelling Practices (Ex 3, and 4)	Theory Portions and Assembled views Manual Drawing (All Portions)	Drafting Practices and Solid modelling Practices. (All Exercises)	Drafting Practices and Solid modelling Practices. (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
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.

1020233540	PRODUCTION DRAWING & MODELLING	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.

The Assembled views for the exercises during Manual drawing practice should be submitted in the drawing sheet (4 Drawing sheet). The printout of the assembled view during drafting practices should be submitted (4 printout). The printout of the solid modelling practices should be submitted (4 printout). The 12 documents should be kept in a file with a Bonafide certificate.

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

SCHEME OF EVALUATION

Part	Description	Marks
PART A – Drafting Practices		
A	Command / Creation Procedure	10
B	2D View with Dimensions	15
PART B – Solid modelling Practices		
C	Creation Part Modelling	10
D	CAD Modelling (3D)	15
Practical Total		50
E	Practical Documents (As per the portions)	10
Total		60

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3

- **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**	
Manual Assembled Drawing			
Part – A	**Two views of the Assemble Drawing.** Front view and Top View / Side View in the drawing sheet. (With or without section / Half section). (30 + 20 = 50 Marks). Any one exercise can be given by lot.	Front View - 30 Marks. Top View / Side View - 20 Marks.	50 Marks
Theory Portions			
Part – B	20 One Mark questions (MCQ) should be answered.	20 X 1 Mark	20 Marks
Part – C	Three Ten Marks questions should be answered from Six questions.	3 X 10 Marks	30 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.

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

Part	Description	Marks
PART A – Drafting Practices		
A	Command / Creation	10
B	2D View with Dimensions	15
C	Printout	5
PART B – Solid modelling Practices		
D	Creation Part Modelling	10
E	CAD Modelling (3D)	15
F	Assembly of the parts	20
G	Printout	5
H	Written test (Theory Portions only)	10
I	Viva Voce	10
TOTAL MARKS		**100**

Note: For the written test 10 MCQ shall be asked from the theory portions.

Syllabus contents

Theory Portion	
SECTIONAL VIEWS Sectioning - sectional views – representation of sectional plane – hatching – inclination – spacing – hatching large areas – hatching adjacent parts - full section – half section – types of half sections – conventional representation of materials in section. **GEOMETRIC DIMENSIONING AND TOLERANCES.** Importance of GD&T - Tolerance specification and interpretation - Tolerance symbols - Features - Datum plane and Axis - Shaft basis and hole basis system.	15

1020233540	PRODUCTION DRAWING & MODELLING	L	T	P	C
PRACTICUM		1	0	4	3

Material Condition Modifiers. Maximum Material Condition (MMC) - Least Material Condition (LMC) - Feature Control Frames	
Manual Drawing Practice	
Detailed drawings of the following machine components will be given to students to draw the assembled views. Only the assembled Front view (Without section / Full Section / Half Section) and Top view or Side view (Without section / Full Section / Half Section) with dimensions and Bill of materials in the Drawing Sheet. Note: All the exercises drawing sheet should be submitted for the model and end semester examination as a record of work done.	15
COMPUTER AIDED DRAFTING (CAD) PRACTICES	
PART A - Drafting Practices: 2D Drafting Practices - Draw the front view of the assembled drawing of the components with dimensions.	15
PART B - Solid modelling Practices: Detailed drawings of the machine components will be given to students to create the solid modelling and assemble using any CAD software in the computer and take the printout.	15
Machine Components for the Practical Exercises	
1. Sleeve and Cotter Joint. 2. Plummer Block. 3. Flange Coupling. 4. Bushed Bearing.	
Practice + Test + Revision	15

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

- Students should practice production drawing with the GD&T representation.
- Modelling competitions can be arranged.

Text and Reference Books:

1. A beginner's guide to 3D modeling by Cameron Coward
2. Solidworks 2022 step by step guide by Amit Bhatt and Mark Wiley

Web-based/Online Resources:

- https://www.autodesk.in/campaigns/autocad-tytorials
- https://www.mycadsite.com/tutorials.html
- NPTEL Lecturers

Equipment / Facilities required to conduct the Practical Course.

1. Personal computer – 30 Nos.
2. Printer – 1 No.
3. Required Software: CAD Package/ Parametric Software packages– Sufficient to the strength.

1020233540	PRODUCTION DRAWING & MODELLING	L	T	P	C
PRACTICUM		1	0	4	3

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

Note: All the exercises should be completed before the Board Practical Examinations. End Semester Practical examination should be conducted for all exercises for 100 Marks as per the pattern. Students will be permitted to select any one exercise by lot or question paper supplied by the DOTE Exam section shall be used.

Practical documents should be submitted for the End Semester Examination with a bonafide certificate.

SCHEME OF EVALUATION

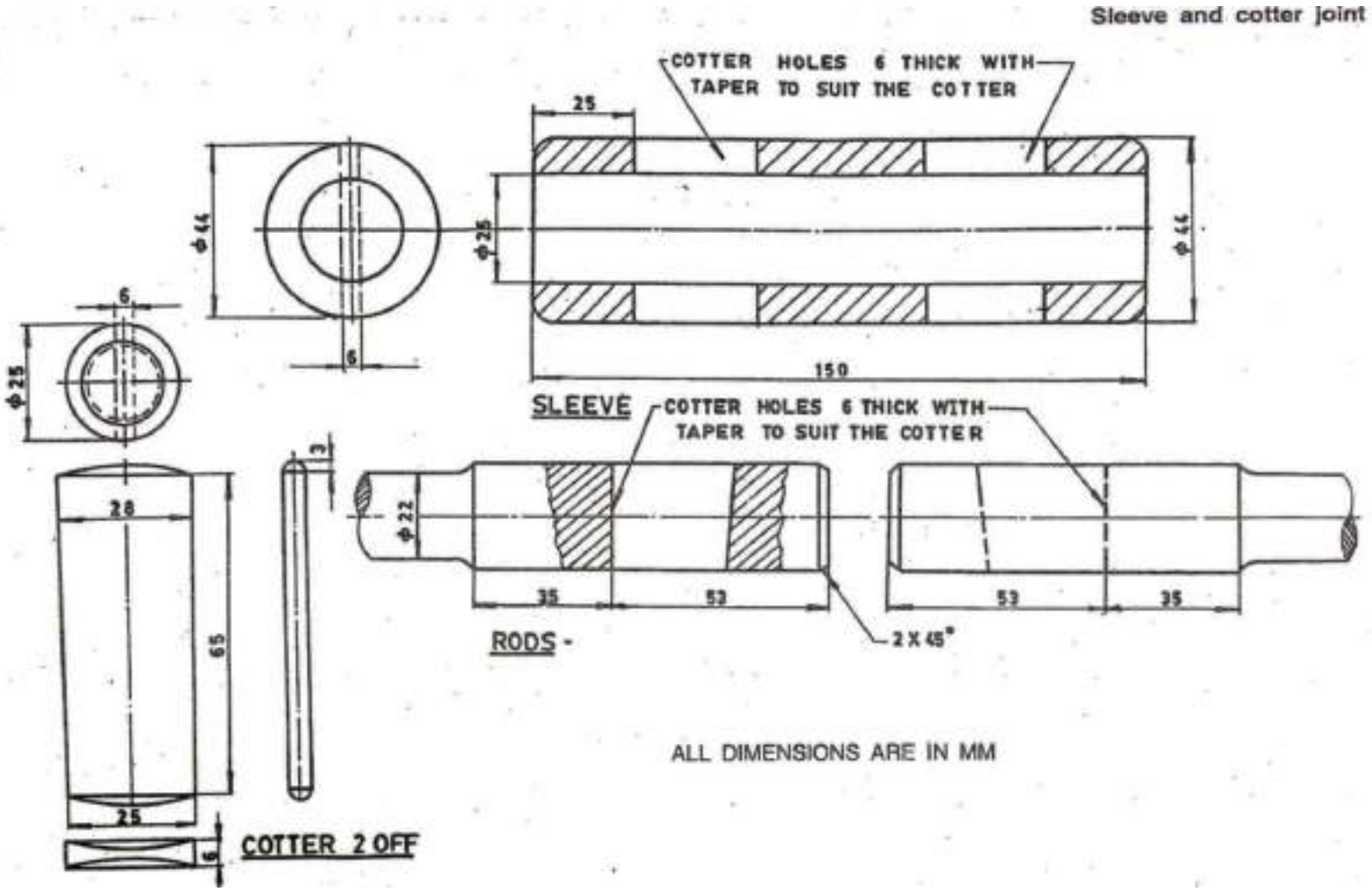
Part	Description	Marks
PART A – Drafting Practices		
A	Command / Creation	10
B	2D View with Dimensions	15
C	Printout	5
PART B – Solid modelling Practices		
D	Creation Part Modelling	10
E	CAD Modelling (3D)	15
F	Assembly of the parts	20
G	Printout	5
H	Written test (Theory Portions only)	10
I	Viva Voce	10
TOTAL MARKS		**100**

Note: For the written test 10 MCQ shall be asked from the theory portions.

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3

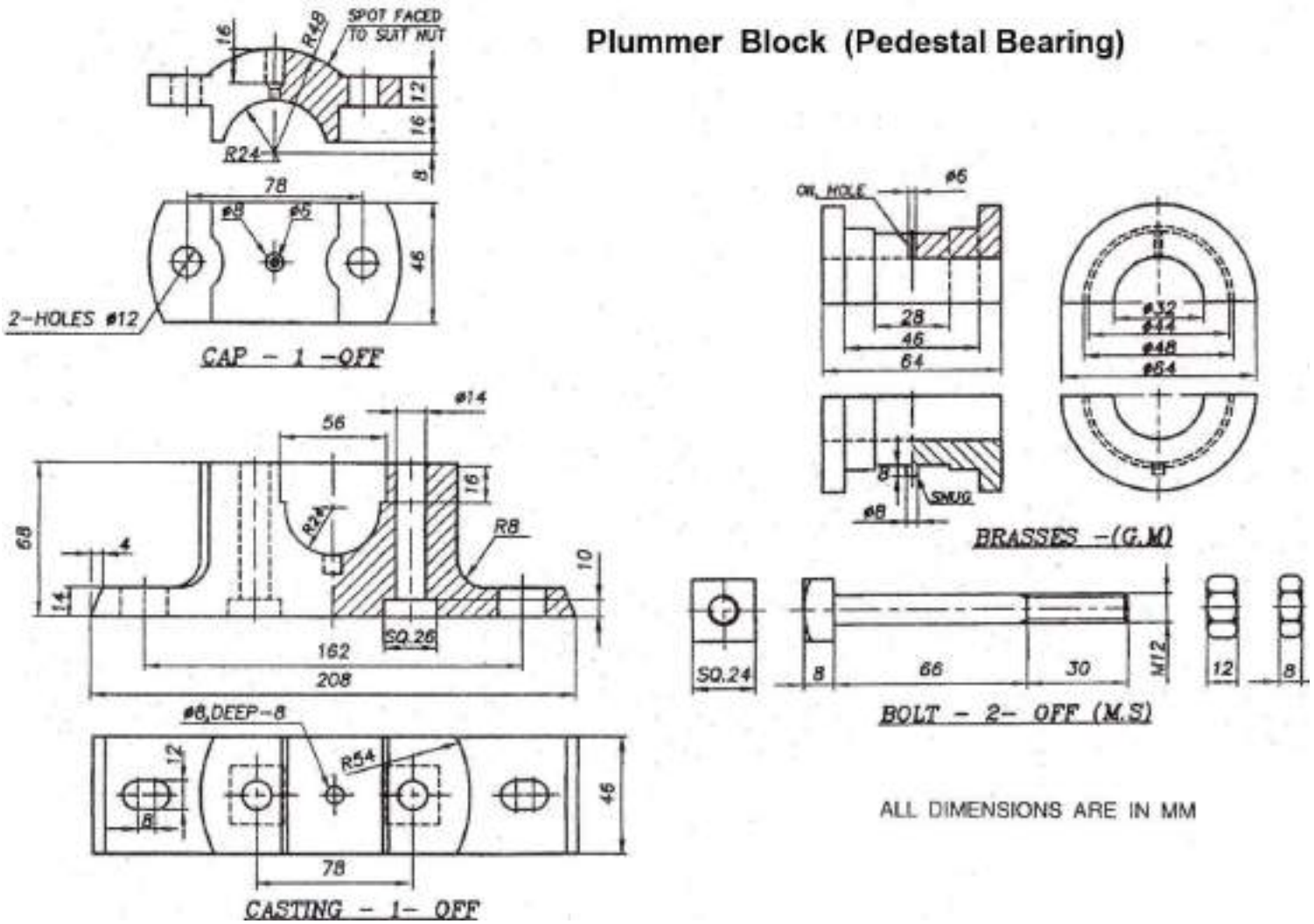
EXERCISE DRAWINGS

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3



1020233540	PRODUCTION DRAWING & MODELLING	L	T	P	C
PRACTICUM		1	0	4	3

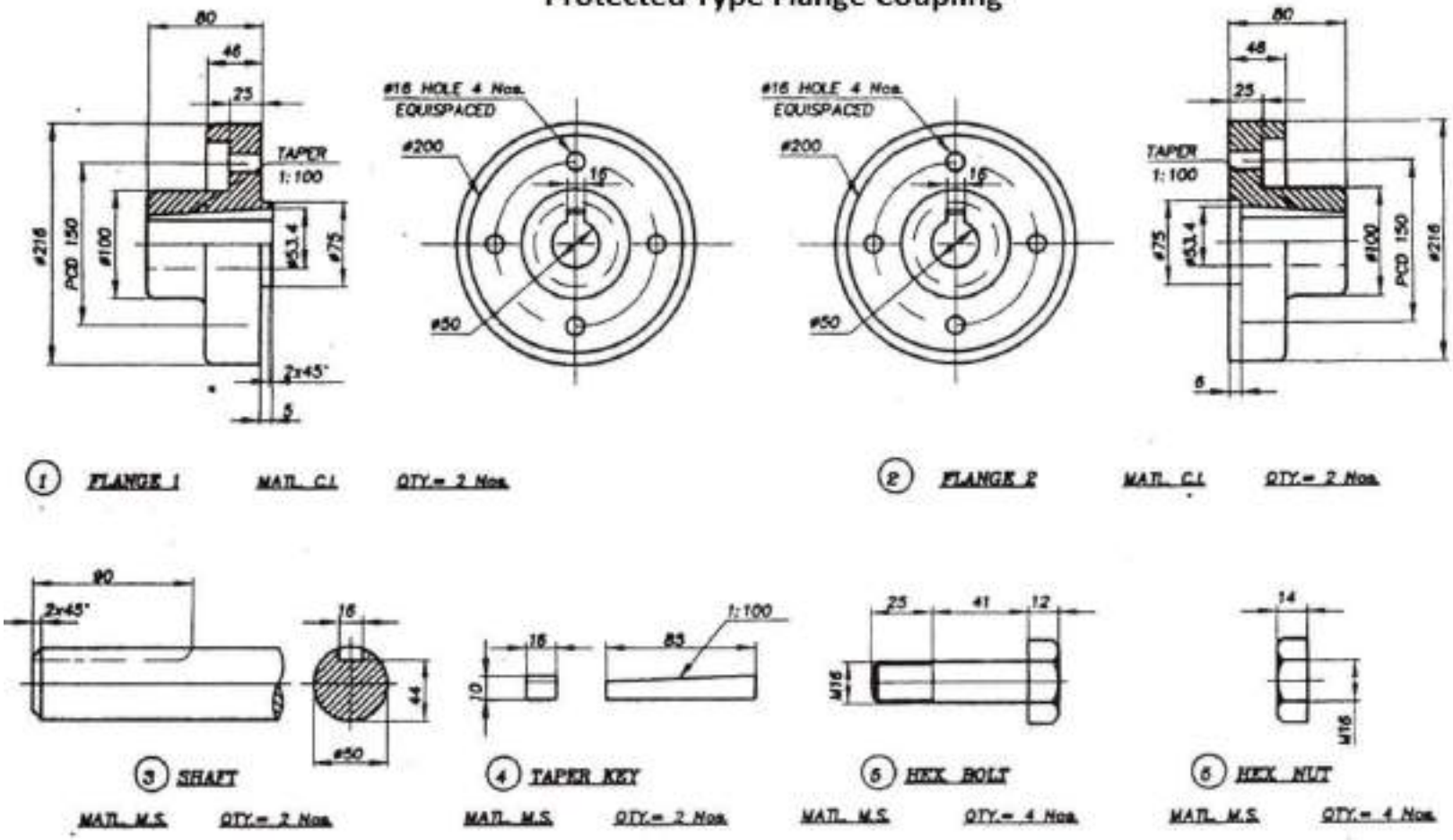
Plummer Block (Pedestal Bearing)



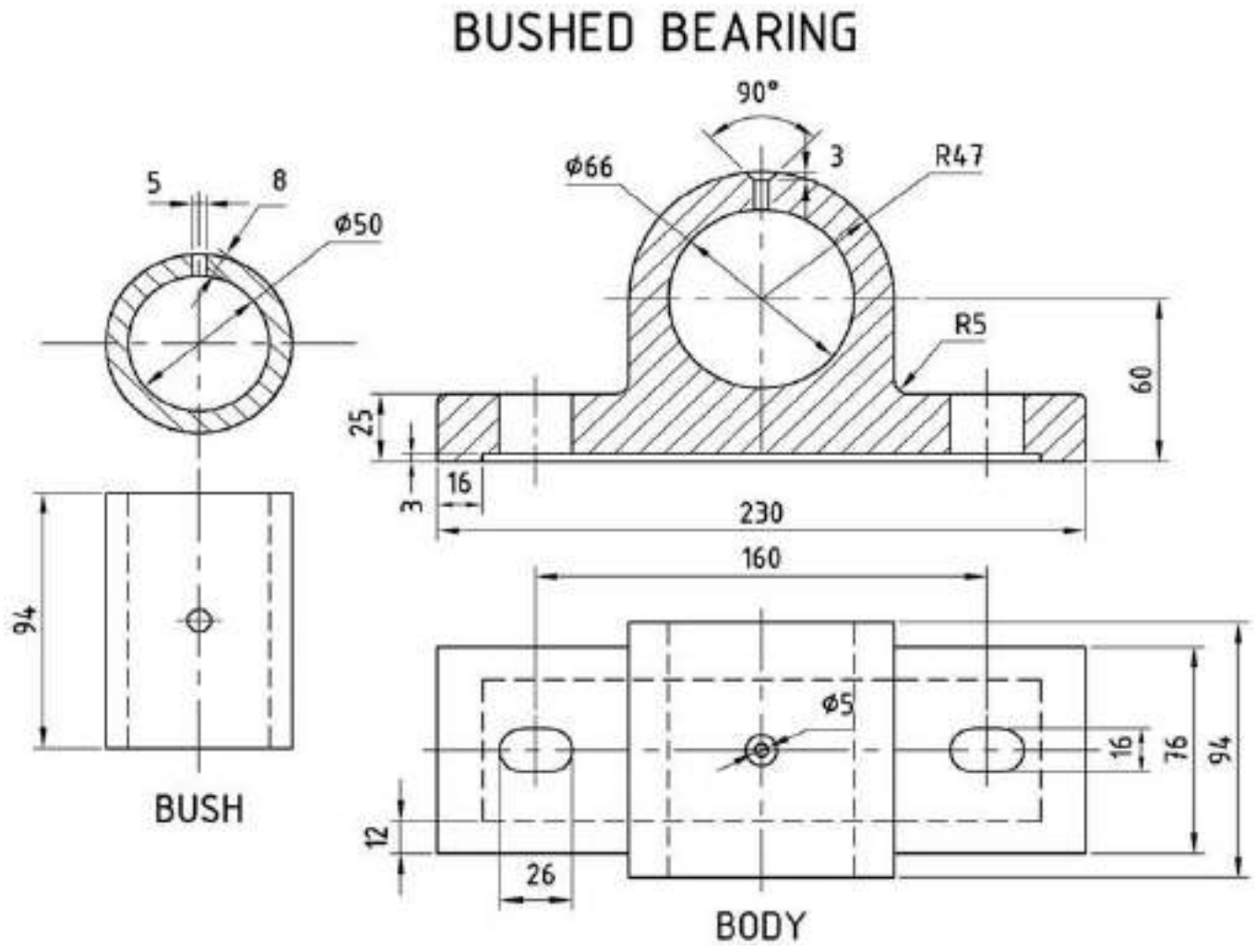
ALL DIMENSIONS ARE IN MM

1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3

Protected Type Flange Coupling



1020233540	**PRODUCTION DRAWING & MODELLING**	L	T	P	C
PRACTICUM		1	0	4	3



1025233640	METROLOGY AND METALLOGRAPHY	L	T	P	C
PRACTICUM		1	0	4	3

INTRODUCTION

The evolution in metrology and metallography is substantially vital and has led to improvements in product quality, enriched scientific research capabilities, and increased efficiency in diverse industries like manufacturing, automobiles, aerospace, and quality control. Metrology is the science of measurement. It deals with the theoretical and practical aspects of measurement, including the development of measurement standards, calibration techniques, and measurement methods. In the context of materials science and engineering, metrology plays a crucial role in ensuring the accuracy and reliability of measurements related to the properties of materials. Metallography, on the other hand, is the study of the microstructure of metals and alloys. Metallography allows engineers and scientists to analyze the internal structure of materials at the microscopic level. By understanding microstructures, researchers can predict and control material properties and assess material performance under different conditions. Together, metrology and metallography provide a comprehensive toolkit for characterizing the properties and behavior of materials, from macroscopic dimensions to microscopic structure.

Course Objectives:

The objective of this course is to prepare the student

- To provide a solid foundation in the principles of measurement, including accuracy, precision, calibration, and uncertainty analysis.
- To acquire knowledge regarding the measurement of linear and angular dimensions of components and assemblies.
- To familiarize the properties, behavior, and characteristics of various engineering materials such as metals, polymers, ceramics, and composites.
- To introduce students to the principles of metallography, including sample preparation techniques and microscopic examination methods.
- To introduce a variety of nondestructive testing methods, such as magnetic particle testing (MT), liquid penetrant testing (PT), visual testing (VT).
- To demonstrate how metrology and metallography are used in material selection, process optimization, failure analysis, and research and development across various industries.

1025233640	METROLOGY AND METALLOGRAPHY	L	T	P	C
PRACTICUM		1	0	4	3

COURSE OUTCOMES:

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

CO1: Comprehend the use of metrology instruments and measurement methods.

CO2: Demonstrate the necessary skills for the calibration and testing of different gauges and measuring instruments.

CO3: Measure the geometrical dimensions of V-threads and Spur gears.

CO4: Identify the given specimen microstructure using a metallurgical microscope.

CO5: Inspect cracks in casting using dye penetrate test and magnetic particle test.

Pre-requisites: Knowledge of basic measuring instruments.

CO/PO MAPPING:

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

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

INSTRUCTIONAL STRATEGY

- It is advised that teachers take steps to interest pupils' attention and boost their curiosity to learn through pre-session reading materials, videos, or online resources to familiarize students with the theoretical concepts of metrology and metallography.
- Conduct a pre-session quiz or assessment to gauge students' understanding of the concepts.
- Start the practical session with a brief overview of the equipment used in metrology and

metallography, including microscopes, calipers, micrometers, and metallographic sample preparation equipment.

- Emphasize safety procedures and protocols, including proper handling of equipment, use of personal protective equipment (PPE), and safe handling of chemicals.
- Offer feedback on students' performance during the practical session, focusing on both technical skills and conceptual understanding and conduct post-session assessments to evaluate students' learning outcomes and identify areas for improvement.
- Gather feedback from students about their learning experience and use it to refine future iterations of the instructional strategy.

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

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PRACTICUM		1	0	4	3

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.

  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 observations, readings, calculations and sketches should be written by the student manually in the document.

  The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook 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 / Least Count	15
B	Reading & Calculation / Preparation and Observation	25
C	Result	10
D	Practical Documents (As per the portions)	10
TOTAL MARKS		60

Cycle - I Exercise 1, 2, 3, 4, 5, 6 and 7.

Cycle - II Exercise 8, 9, 10, 11, 12 and 13.

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PRACTICUM		1	0	4	3

- **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 from the complete theory portions.	30 X 1 Mark	30 Marks
Part – B	Seven Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

- **CA4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one question 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
Metrology Section: (Any one question from Ex. 1,2,3,4,5,6 and 7)		
A	Procedure / Least Count	5
B	Reading & Calculation	20
C	Result	10
Metallography Section: (Any one question from Ex. 8,9,10,11,12 and 13)		
D	Procedure	5
E	Preparation and Observation	20
F	Result	10
G	Written test	30
	TOTAL MARKS	**100**

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

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PRACTICUM		1	0	4	3

SYLLABUS CONTENTS

THEORY

UNIT I: LINEAR, ANGULAR MEASUREMENTS AND FORM MEASUREMENTS	**Periods**
Basics of Metrology: Scope of Metrology, basic units, important terminology, Measurement – Need, Process, Role in quality control; Factors affecting measurement – international standardization, the bureau of Indian standards – important elements of measurements – methods of measurements. sensitivity, stability, range, Precision and Accuracy- definition – reliability – definition , error – definition – sources of errors – classification of error – Calibration of measuring instruments. **Linear Measurements:** Linear Measuring Instruments – Vernier caliper, Micrometer, Depth Micrometer – Use and precautions, possible sources of errors in vernier caliper and micrometer– slip gauges –requirements – Indian standard – care and use. **Angular Measurements:** Angular measuring instruments – Introduction – vernier bevel protractor – universal bevel protractor – optical bevel protractor. Sine bar – types – uses and limitations – working principle of clinometer, autocollimator, angle dekkor. **Form Measurement:** Screw thread terminology – Screw thread micrometer – measurement of various elements of thread – Vernier gear tooth caliper – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement.	7

Practical Exercises:

Ex. No	**Name of the Experiment**	**Hours**
1.	**VERNIER CALIPER** i) Measure the dimensions of ground MS flat/Cylindrical bush using Vernier Caliper. ii) Compare the results with Digital Vernier Caliper.	4

2.	**MICROMETER** i) Measure the diameter of a wire using a micrometer. ii) Compare the results with a digital outside micrometer.	4
3.	**SLIP GAUGES** Measure the thickness of ground MS plates using slip gauges.	4
4.	**UNIVERSAL BEVEL PROTRACTOR** Measure the angle of a V-block/Taper Shank of Drill/ Dovetail using universal bevel protractor.	4
5.	**SINE BAR** Measure the angle of the machined surface using sine bar with slip gauges.	4
6.	**SCREW THREAD MICROMETER** Measure the geometrical dimensions of V-Thread using screw thread micrometer.	4
7.	**GEAR TOOTH VERNIER CALIPER** Measure the geometrical dimensions of spur gear using gear tooth vernier caliper.	4

THEORY

UNIT II : STRUCTURE OF SOLIDS, PHASE DIAGRAMS, ENGINEERING MATERIALS AND TESTING OF MATERIALS

Structure of Solids: Introduction to Atomic Structure – Crystal Structure – Unit Cell and Space Lattice – Crystal System – The seven basic crystal systems – Crystal structure for Metallic Elements – BCC, FCC, and HCP – Definition – Coordination Number – Atomic Radius – Atomic Packing Factor for Simple Cubic, BCC, FCC, and HCP structures. **Phase Diagrams:** Isomorphous, Eutectic and Eutectoid systems – Iron Carbon equilibrium diagram. **Engineering Materials:** Classification – Ferrous and Nonferrous metals and their alloys – Definition of Mechanical properties. **Testing of Materials:** Destructive Testing – Types – Non-destructive testing – Visual Inspection – Magnetic Particle inspection – Liquid penetrant test – Ultrasonic inspection, Radiography (Descriptive treatment only).	6

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PRACTICUM		1	0	4	3

Practical Exercises:

Ex. No.	Name of the Experiment	Hours
8.	**METALLURGICAL MICROSCOPE** Find the grain structure of the given specimen using the Metallurgical Microscope.	4
9.	Prepare a specimen to examine the microstructure of the Ferrous metal.	4
10.	Prepare a specimen to examine the microstructure of the Nonferrous metal.	4
11.	**NON-DESTRUCTIVE TESTING** Detect the cracks in the specimen using Visual Inspection and ring test.	4
12.	Detect the cracks in specimen using Dye penetration test.	4
13.	Detect the cracks in specimen using Magnetic particle test.	4
	Activity + Revision + Assessment Test	10
	TOTAL HOURS	**75**

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PRACTICUM		1	0	4	3

Suggested List of Student Activity

Activity 1: Each student writes and submits the assignment on the topic of Methods of measurements, Types of possible errors in measurements, and classification of engineering materials.

Activity 2: Four students can be grouped as a batch to measure the various dimensions of V-Thread and spur gear and submit the activity report. The activity report should have the diagram and various dimensions of the V-Thread and spur gear.

References

1. "Applied Metrology for Manufacturing Engineering", Ammar Grous, J Wiley- ISTE, 2011.
2. "Metrology & Measurements", Anand K Bewoor & Vinay A Kulkarni, Tata McGraw- Hill Education Private Ltd, 2009.
3. "Engineering Metrology", Jain R.K., Khanna Publishers, 2005.
4. "Engineering Metrology and Measurements" Raghavendra N.V. and Krishnamurthy. L., , Oxford University Press, 2013.
5. "Introduction to Physical Metallurgy", Sydney Avner, Tata McGraw-Hill Education Private Ltd.
6. A Textbook of "Material Science & Metallurgy", O.P.Khanna, DhanpatRai Publications Pvt. Ltd., New Delhi

Web-based/Online Resources

- https://youtu.be/WYeNQfGrejM
- https://youtu.be/stasLtabxlk
- https://youtu.be/HYpgpMymDcI
- https://youtu.be/BJrTZ07bHm4
- https://youtu.be/E4T0fnmzgf0
- https://www.youtube.com/watch?v=2agE7N1Bguc

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PRACTICUM		1	0	4	3

END SEMESTER EXAMINATIONS – 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 question (one experiment from Cycle I exercises and one experiment from Cycle II exercises) by lot or question paper supplied by the DOTE Exam section shall be used. The record of work done by the student should be submitted with a Bonafide Certificate.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
Metrology Section: (Any one question from Ex. 1,2,3,4,5,6 and 7)		
A	Procedure / Least Count	5
B	Reading & Calculation	20
C	Result	10
Metallography Section: (Any one question from Ex. 8,9,10,11,12 and 13)		
D	Procedure	5
E	Preparation and Observation	20
F	Result	10
G	Written test	30
	TOTAL MARKS	**100**

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

1025233640	METROLOGY AND METALLOGRAPHY	L	T	P	C
PRACTICUM		1	0	4	3

LIST OF EQUIPMENTS

S.No	Name of the Equipment	Quantity required
1.	Vernier Caliper	2 Nos.
2.	Digital Vernier Caliper	2 Nos.
3.	Micrometer	2 Nos.
4.	Digital Micrometer	2 Nos.
5.	Slip Gauges	2 Nos.
6.	Surface Plate	2 Nos.
7.	Dial Indicator (0-10)	2 Nos.
8.	Universal Bevel Protractor	2 Nos.
9.	Sine Bar with Slip gauges	2 Nos.
10.	Screw Thread Micrometer	2 Nos.
11.	Gear Tooth Vernier Caliper	1 No.
12.	Metallurgical Microscope	2 Nos.
13.	Dye penetration	2 Nos.
14.	Magnetic particle test	1 No.
15.	Abrasive belt grinder	1 No.
16.	Polishing machine	1 No.
17.	Mounting machine	1 No.
18.	Specimens	Sufficient quantity(Ferrous/Non-ferrous metals)
19.	Consumables	Sufficient Quantity

1020234110	**ADVANCED MANUFACTURING TECHNOLOGY**	L	T	P	C
THEORY		3	0	0	3

Introduction:

Use of innovative technologies to create existing products and the creation of new products. Advanced manufacturing can include production activities that depend on information, automation, computation, software, sensing, and networking

Course Objectives:

- Explain the different methods of plastic manufacturing processes
- Explain the various concepts of modern machining, super finishing process and surface treatment
- To make acquainted the various unconventional manufacturing processes
- Write part program for manufacturing components in CNC machines
- Explain the rapid prototyping technologies in manufacturing

Course Outcomes:

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

CO1: Describe the various methods of plastic manufacturing

CO2: Explain the modern machining processes, super finishing processes and various surface treatment methods

CO3: Describe the unconventional Machining processes

CO4: Explain the CNC Machines and ability to apply "G codes" and "M codes in CNC programming

CO5: Apply the rapid prototyping technologies in manufacturing

Pre-requisites:

Production Technology, Machine Tools, Metal Cutting, Computer applications

1020234110	ADVANCED MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping

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

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

Instructional Strategy:

- Engage and Motivate: Teachers should actively engage students to boost their learning confidence
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations, and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome- and employability-based.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities ina simulated environment, transitioning to real-world scenarios when possible.

1020234110	**ADVANCED MANUFACTURING TECHNOLOGY**	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written test (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).

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.

1020234110	ADVANCED MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

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	**Types of plastics and processing of plastics**	
Types of Plastics: Engineering plastics – thermosets – comparison of thermoplastic and thermosetting plastics - composite - structural foam, elastomers - polymer alloys and liquid crystal polymers. **Processing of Plastics** Extrusion - single screw extrusion - twin screw extruders and types - Injection moulding types: Plunger type - Reciprocating screw injection - structural foam injection mould - sandwich moulding - gas injection moulding – calendaring and rotational moulding. Design consideration for plastic components.		9
Unit II	**Modern Machining ,Super finishing and Surface treatment processes**	
Modern Machining Processes: Precision and ultra precision machining - Micro and nano machining and High-speed Machining – hot machining-basic principles, working, applications, advantages **Super finishing processes :** introduction– working principle of Honing – lapping –burnishing – polishing –buffing – advantages - applications		9

1020234110	ADVANCED MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Surface treatment processes: Introduction – working principle – surface hardening - shot peening - galvanizing – powder coating - thermal spraying - Vapour deposition Process types - Chemical Vapour Deposition (CVD) – Physical Vapour Deposition (PVD) - sputtering – Electroplating – cladding – hot dipping – painting - advantages – applications.		
Unit III	**Unconventional Machining Processes**	
Introduction – classification - construction and working principle of abrasive jet machining (AJM) – water jet machining (WJM) – ultrasonic machining (USM) – electrical discharge machine (EDM) - electron beam machining (EBM) – laser beam machining (LBM) – plasma arc machining (PAM) – Chemical Machining (CHM) – Electro Chemical Machining (ECM) -advantages – disadvantages and applications.		8
Unit IV	**CNC Machines and CNC Programming**	
CNC machines: Numerical control – definition – working principle of a CNC system - advantages of CNC machines – difference between NC and CNC – construction and working principle of turning centre – construction and working principle of machining centre - machine axes conventions turning centre and machining centre – coordinate measuring machine (CMM) – construction and working principle. **CNC Programming:** Introduction – Cartesian coordinate system – Polar coordinate system –Absolute and incremental positioning – Purpose of G and M codes. – CNC program. Procedure - Homing position – Offset setting -Work offset setting procedure – Tool offset - CNC turning program using linear interpolation and circular interpolation.– CNC milling program using linear interpolation and circular interpolation - . compensation		11

1020234110	ADVANCED MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Unit V	Rapid Prototyping	
Introduction - Classification –subtractive – additive – advantages and applications – materials- Working Principles, Methods, Stereolithography, Laser Sintering, Fused Deposition Method, 3D printing - Working Principle - Applications and Limitations, Rapid tooling, Overview of other techniques in rapid manufacturing.		8
	TOTAL HOURS	45

Suggested List of Students Activity:

- Presentation/Seminars by students on any recent technological developments based on the course
- Online MCQ have to be conducted for all the five units.
- Blended learning activities to explore the recent trends and developments in the field.

Text and Reference Books:

1. V. K. Jain, Advanced Machining Processes, 1 st edition , Allied Publications,2010.
2. Mikell P. Groover , Automation, Production Systems, and Computer- Integrated Manufacturing, 3 rd edition, Pearson Education Asia,2008.
3. P. Radhakrishnan, S. Subramanyam, CAD/CAM/CIM,2 nd edition, New Age International,2008.

Web-based/Online Resources:

- https://archive.nptel.ac.in/courses/112/107/112107078/
- https://onlinecourses.nptel.ac.in/noc24_me72/preview

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.

1020234230	FLUID MECHANICS	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

The principles of fluid mechanics play a vital role in various aspects of our daily lives, influencing everything from the functioning of essential machines to the natural phenomena that shape our world. Understanding the significance of fluid mechanics helps us appreciate its impact on diverse fields. It is a cornerstone of modern engineering and science, with profound implications for numerous aspects of our lives. Its principles enable advancements in technology, contribute to environmental sustainability, and enhance our understanding of the natural world.

Course Outcomes:

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

CO1: Describe the measurement of fluid pressure and its applications.

CO2: Measure the flow rate of fluid by using venturi meter and orifice meter.

CO3: Compute the friction factor for the pipeline.

CO4: Analyse the performance of turbines.

CO5: Evaluate the performance of pumps

Pre-requisites:

Mathematical skills, Mechanics.

CO/PO Mapping

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

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

1020234230	**FLUID MECHANICS**	L	T	P	C
PRACTICUM		2	0	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.
- 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 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 Periods	2 Periods	3 Hours	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	

1020234230	**FLUID MECHANICS**	L	T	P	C
PRACTICUM		2	0	2	3

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.
  Answer any 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.

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical documents to be prepared as per the instruction below. Each experiment observation and calculations should be completed on the day ofpractice. 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 student should write the reading and calculations, and the result and graph should be prepared manually.

  The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

1020234230	**FLUID MECHANICS**	L	T	P	C
PRACTICUM		2	0	2	3

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Apparatus required	10
B	Procedure / Observation / Tabular column	20
C	Formula / Calculation	20
D	Result / Graph	10
E	Practical document (All Experiments)	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.

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

1020234230	FLUID MECHANICS	L	T	P	C
PRACTICUM		2	0	2	3

Syllabus Contents

Unit I	**FLUID AND FLUID PROPERTIES**	
Theory: Concept and classification of fluid, Properties of fluid - Density - Specific weight - Specific volume - Specific gravity - Viscosity - Surface tension - Cohesion & Adhesion – Capillarity - Bulk modulus of elasticity - Vapor Pressure - Description and Simple problems.		5
Practical: 1. Demonstrate various fluid properties viscosity, surface tension, cohesion & Adhesion and capillarity.		2
Unit II	**PRESSURE MEASURING DEVICES**	
Theory: Pressure head- atmospheric gauge and vacuum pressure – Classification of pressure measuring devices - Working and application of pressure measuring devices: Piezometer- Simple U tube manometers – Differential U tube manometers – problems - Pressure Gauges - Description.		5
Practical: 2. Measure the fluid pressure using a simple manometer and pressuregauge. Find the pressure difference using differential manometer.		3
Unit III	**FLUID KINEMATICS & FLUID DYNAMICS**	
Theory: Fluid Kinematics: Streamline, path line and streak lines and stream tube, classification of fluid flows-Reynolds number, steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow. Fluid Dynamics: Energies of fluid-Bernoulli's equations for flow along a streamline - Description and simple problems - Applications of Bernoulli's theorem - Venturimeter and Orificemeter - Description.		8

1020234230	**FLUID MECHANICS**	L	T	P	C
PRACTICUM		2	0	2	3

Practical: 3. Verify Bernoulli's theorem. 4. Measure the discharge of the fluid flow using venturi meter or Orifice Meter.		6
Unit IV	**FLOW THROUGH PIPES**	
Theory: Introduction to pipe and pipe flow - Major and minor losses - Reynold's experiment, friction factor, Darcy's and Chezy's equations - Description only, Moody's chart- Water hammer and cavitation, its cause, effect, and remedies.		4
Practical: 5. Find the friction factor for the given pipeline.		3
Unit V	**HYDRAULIC MACHINES**	
Theory: Reciprocating Pump: classifications - single and Double Acting Reciprocating Pump - Working - Discharge, coefficient of discharge, Air vessels. Centrifugal Pump: Classification - working of Single stage Centrifugal Pump - Main components of centrifugal pump - head of pump - priming - self priming – pumpsin series & parallel - losses in centrifugal pumps - selection of pump. Hydraulic Turbines: Introduction - Classification of turbines, impulse turbine - construction and working of impulse turbine - reaction turbines - construction and working of Francis turbine and Kaplan turbine - draft tube and its types – surge tank - selection of hydraulic turbines.		8
Practical: 6. Perform a test on the reciprocating pump or centrifugal pump test rig and find the efficiency. 7. Perform a test on a hydraulic turbine test rig and find the efficiency.		6
Test + Revision		10
TOTAL HOURS		60

1020234230	FLUID MECHANICS	L	T	P	C
PRACTICUM		2	0	2	3

Suggested List of Students Activity:

- Compare the following liquids concerning their density (for the same mass, compare the volume) (1) Petrol (2) Water (3) Edible oil (4) Caster oil (5) Mercury
- Compare the following liquids concerning their viscosity (for the same temperature, compare the velocity) (1) Petrol (2) Water (3) Edible oil (4) Caster oil (5) Mercury
- Calculate the water weight when your home's water tank is completely filled with water.
- Observe the working of a Hydraulic Jack and relate it with Pascal's law.
- Observe the discharge water condition from a pipe at the time of car washing with a nozzle and without a nozzle and explain the difference considering Bernoulli's equation.
- Draw a line diagram of the water supply & distribution line of your hydraulic lab and indicate the source of major and minor losses in it.
- Visit the manufacturer's website for hydraulic pumps, collect the catalog, and select a suitable pump for your home application.
- Prepare a demonstration model of the hydroelectric power plant.
- Prepare a demonstration model of the hydraulic devices.
- Observe pressure gauges used by roadside tire workers, blood pressure measurement by doctors and pressure gauges mounted on a turbine test rig and write a report on it.
- Prepare a report on real life applications of hydraulic systems and pneumatic systems at your college.

Textbooks & Reference Books:

1. A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines, R.S. Khurmi, - Edn.18, S.Chand & Co., New Delhi.
2. A Textbook of Fluid Mechanics and Hydraulic Machines – by R. K Rajput and and S.Chand & Co, New Delhi.
3. Hydraulic Machines, Jagadishlal, , Metropolitan Book Co. Pvt. Ltd., New Delhi.
4. Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi Publications Pvt., Ltd, New Delhi.

1020234230	FLUID MECHANICS	L	T	P	C
PRACTICUM		2	0	2	3

Web-based/Online Resources:

1. https://nptel.ac.in/courses/112105206
2. https://nptel.ac.in/courses/112104117
3. https://nptel.ac.in/courses/112103249
4. https://www.classcentral.com/course/youtube-fluid-mechanics-concept-derivation-videos-53034
5. https://fmc-nitk.vlabs.ac.in/fluid-machinery/exp/centrifugal-pump/index.html
6. https://me.iitp.ac.in/Virtual-Fluid-Laboratory/
7. https://eerc03-iiith.vlabs.ac.in/List%20of%20experiments.html
8. https://fm-nitk.vlabs.ac.in/List%20of%20experiments.html

Equipment / Facilities required for conducting the Practical Course.

1. Pressure Measuring Devices — Sufficient quantity.
2. Bernoulli's theorem experimental set up — 1 no.
3. Venturi Meter or Orificemeter experimental setup — 1 no.
4. Pipe friction factor experimental set up — 1 no.
5. Centrifugal Pump experimental set up (or) Reciprocating Pump experimental set up — 1 no.
6. Hydraulic turbine test rig. — 1 no.

Required instruments and consumables.

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.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

INTRODUCTION:

Metal cutting is a fundamental process in manufacturing industries where raw metal materials are shaped into desired forms through various cutting techniques. This process is essential for creating precision components used in industries ranging from automotive and aerospace to electronics and construction. One of the most advanced methods for metal cutting is Computer Numerical Control (CNC) machining. CNC machines are automated tools that use computerized controls to precisely execute pre-programmed commands. These commands dictate the movement of cutting tools and the rotation of workpieces, allowing for highly accurate and repeatable production processes. These machines offer several advantages over traditional manual machining methods, such as increased productivity, consistency, and the ability to produce complex geometries with tight tolerances.

COURSE OBJECTIVES:

- Expose to the Concept and Basic Mechanics of Metal Cutting.
- Familiarize with working Standard Machine Tools such as Lathe and Milling.
- Familiarize with the working of the Grinding Process.
- Features and selection of CNC turning and milling machines.
- Practice in part programming and operation of CNC turning machines, subroutine techniques, and use of cycles and machining the components using CNC machines.
- Study the working of 3D printing and its applications.

COURSE OUTCOMES:

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

- **CO1:** Understand the concept and basic of Mechanics of Metal Cutting.
- **CO2:** Know the operations of Lathe, Milling, grinding, shaper, slotter machines, and demonstrate the need for such machines for sustainable development.
- **CO3:** Develop proficiency in operating CNC machines, including setting up workpieces, tooling, and executing machining operations accurately and efficiently.
- **CO4:** Create simple components using CNC tuning and milling centers.
- **CO5:** Understand the working and applications of 3D printing.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

PRE-REQUISITES:

- Basic working practice of Lathe, Milling, and grinding machines.
- Basic knowledge and working principles of CNC machines and 3D printing.

CO/PO Mapping

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

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

INSTRUCTIONAL STRATEGY:

- Engage and Motivate: Teachers should actively engage students to boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area. Teachers should provide examples from daily life, realistic situations, and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is the outcome and employability-based.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

ASSESSMENT METHODOLOGY:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	First Cycle	Second Cycle	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 Marks	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 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.

  Cycle 1 - Exercises 1, 2, 3, 4, 5 and 6.

  Cycle 2 - Exercises 7, 8, 9, 10, 11 and 12.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Tools required	10
B	Preparation and Setting / Writing CNC Program / Modelling	20
C	Operation / Machining / Simulation / Slicing	20
TOTAL MARKS		50

- **CA 3:** Practical document 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 part program and sketch should be written by the student manually.

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

- **CA 4:** All the exercises 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 20 Marks for the internal assessment.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Tools required	10
B	Preparation and Setting / Writing CNC Program / Modelling	30
C	Operation / Machining / Simulation / Slicing	30
D	Finish / Output	20
E	Viva Voce	10
	TOTAL MARKS	**100**

SYLLABUS CONTENTS:

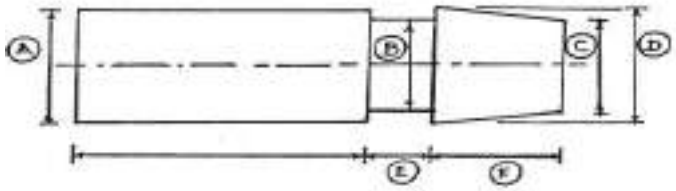
INTRODUCTION	
Metal Cutting: Theory of Metal Cutting: Chip Formation, Orthogonal Cutting – Oblique Cutting – Tool Geometry – Tool nomenclature – Cutting tool materials. Lathe – Centre Lathe: Introduction – specifications – machining operations done on lathe. Milling: Milling cutters – Milling operations – Indexing – Gear cutting. Grinding: Grinding Process – Cylindrical Grinding, Surface Grinding – Tool and cutter grinder. Reciprocating machines: Shaper – Slotter – Planer. **CNC Machines:** Study of CNC lathe, milling – Study of international standard codes: G-Codes and M-Codes. Format – Dimensioning methods. – Program writing – Turning simulator – Milling simulator, IS practice – commands menus – Editing the program in the CNC machines. – Set the machine and execute the program in the CNC machines. **3D Printing:** Introduction – types - modelling software – slicing software – parameters like layer thickness – orientation and infill on build time.	10

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

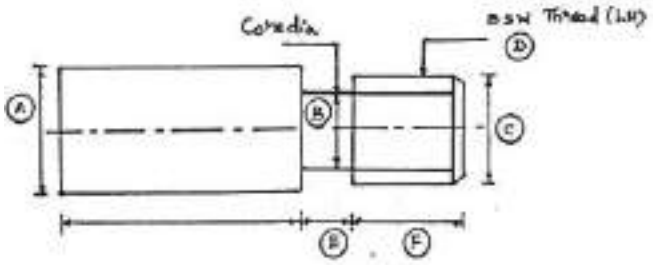
PRACTICAL EXERCISES – CYCLE 1 - METAL CUTTING

I. LATHE

1. Grooving and Taper Turning. — 4

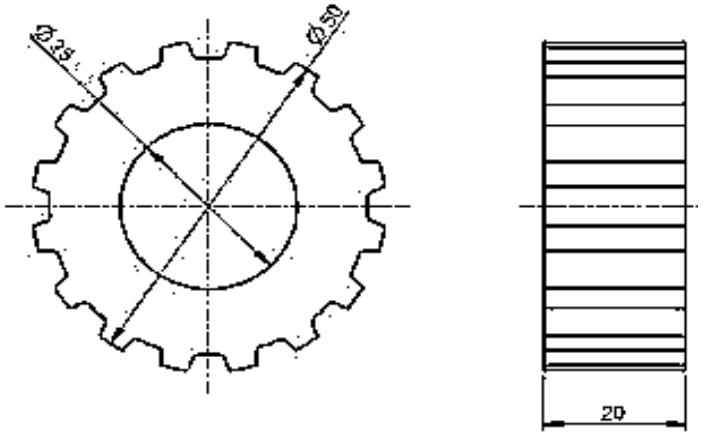


2. Thread cutting. — 2



II. MILLING MACHINE

3. Make Spur Gear using Horizontal milling machine by simple Indexing. — 4

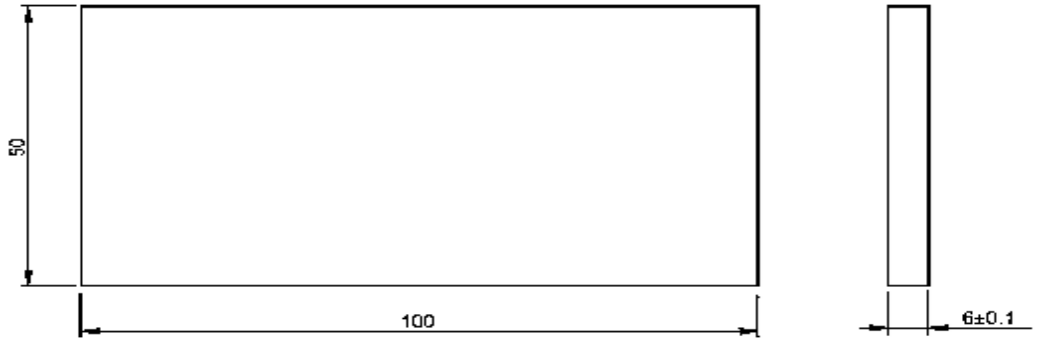


OUTER DIAMETER Ø 50mm
MODULE : 2mm
NO.OF TEETH : 16

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

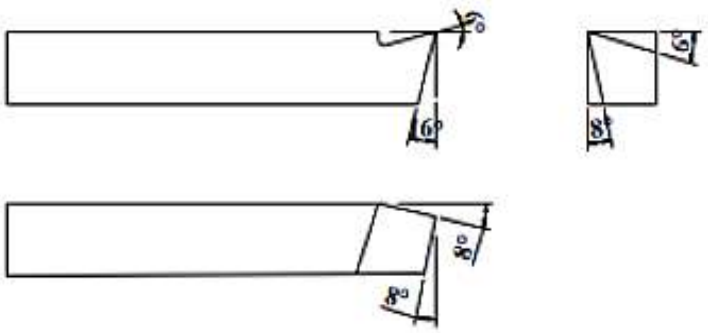
III. GRINDING

4. Grind a plain surface using surface Grinder.



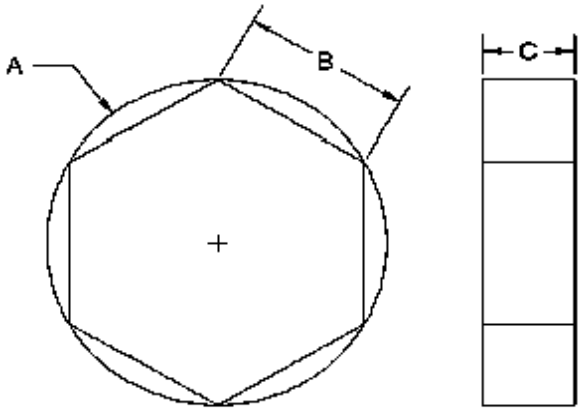
2

5. Make a turning tool using a tool and cutter grinder.



2

6. Make a hexagonal shape component using the shaper machine from the given workpiece.

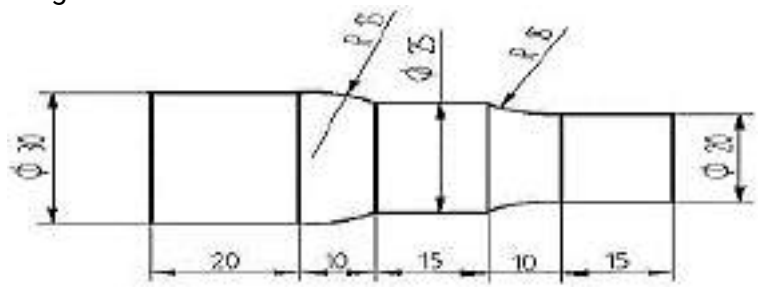


2

PRACTICAL EXERCISES – CYCLE 2 – CNC MACHINES AND 3D PRINTING

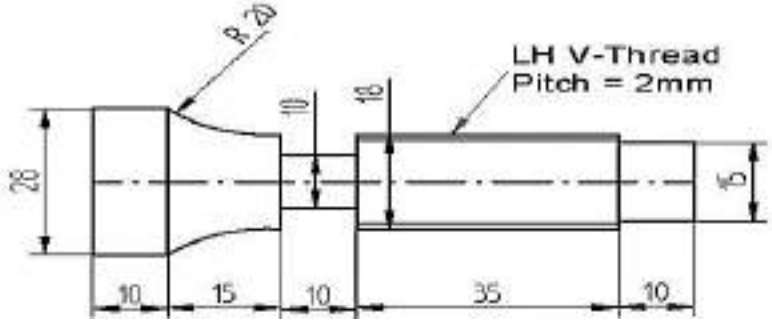
CNC Turning Machine: **Material**: **M.S / Aluminium / Acrylic fibre.**

7. Using linear and circular interpolation create a part program and produce a component in the CNC Turning center. 4



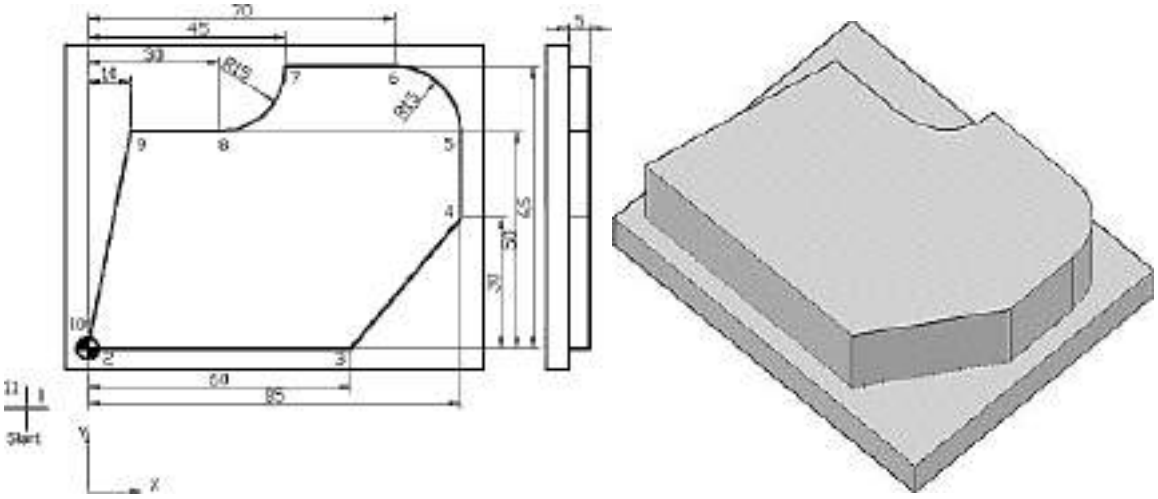
ALL DIMENSIONS ARE in mm.

8. Using canned cycle create a part program for thread cutting, grooving and produce a component in the CNC Turning center. 4



ALL DIMENSIONS ARE in mm.

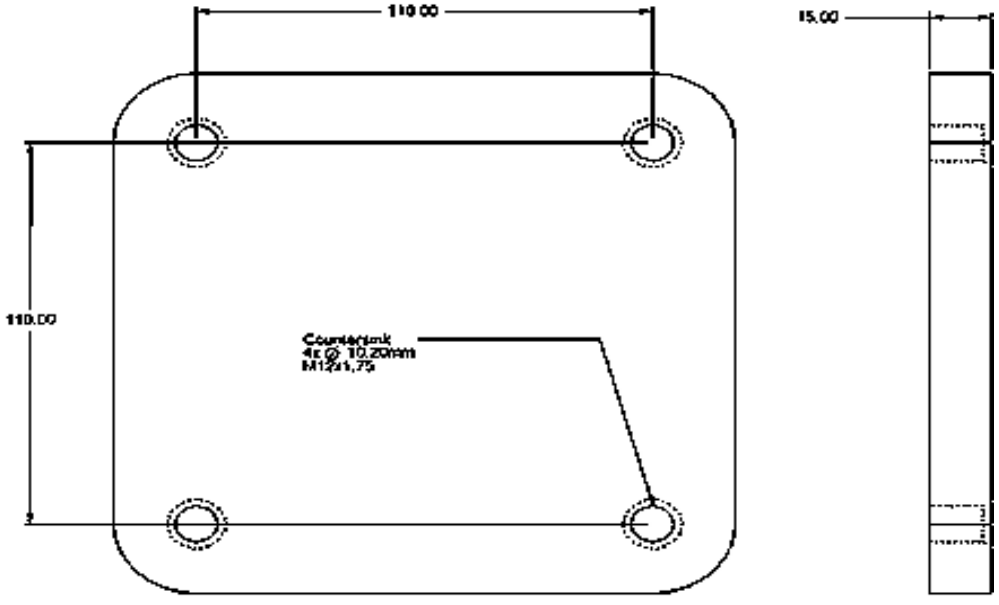
9. Using linear interpolation and circular interpolation, create a part program for contour machining in the VMC.



4

ALL DIMENSIONS ARE in mm.

10. Using canned cycle create a part program for a drilling operation in the VMC.



4

ALL DIMENSIONS ARE in mm.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

11. Model the given engineering component and prepare the .stl file to print using a 3D printer or simulator. - Geneva Wheel.	4
12. Model the given engineering component and prepare the .stl file to print using a 3D printer or simulator. - C Clamp with V Block.	4
Test and Revision	10
Total	**60**

SUGGESTED LIST OF STUDENTS ACTIVITY:

1. Observe the Lathe machine in the institute and study its specifications. List the possible operations that can be done on that machine.
2. Study different reciprocating machines available and draw the line sketch to study the working principle.
3. Study the types of grinding wheels available for industrial applications. Classify the abrasive materials and its properties.
4. Field visit nearby industries based on CNC machines and make report.
5. Visit to any three 3D printing industries and make reports.

TEXT AND REFERENCE BOOKS:

1. "Elements of Workshop Technology" - Vol. I & II, Hajra Choudry & Battacharya, Edn. 11, published by Media Promoters and Publishers Pvt. Ltd., Seervai Buildings `B', 20-G, Noshir Bharucha Marg, Mumbai 400 007 – 2007.
2. "Production Technology", HMT, Edn. 18, published by Tata McGraw Hill Publishing Co. Ltd., 7,West Patel Nagar, New Delhi 110 008.
3. "CNC machines" - by Prof.P Radhakrishnan.
4. "Rapid Prototyping: Principles and Applications" ,Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, , Volume 2.

1025234320	METAL CUTTING, CNC MACHINES AND 3D PRINTING	L	T	P	C
PRACTICAL		0	0	4	2

WEB-BASED/ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=Wc2gpWcmGK4 - Lathe Machine Operations.
2. https://www.youtube.com/watch?v=zzXdddrV2so - Milling machine.
3. www.youtube.com/watch?v=T5gjkYvMg8A
4. https://download.slicer.org/
5. https://youtu.be/eTo70OkrpcQ - FDM.

EQUIPMENT / FACILITIES REQUIRED TO CONDUCT THE PRACTICAL COURSE.

S.NO	NAME OF THE EQUIPMENT	QUANTITY REQUIRED.
1.	Center Lathe 4 ½ ' Bed length	10 Nos.
2.	Cutting Tool H.S.S ¼ " X ¼ " X 4 " long	10 Nos.
3.	4 Jaw / 3 Jaw Chucks, Chuck key (10 mm x 10 mm size)	Required Numbers.
4.	Vernier Caliper, Micrometer, Inside and Outside. (0-25 and 25-50)	Each 5 Nos.
5.	Steel Rule (0-150)	10 Nos.
6.	Outside and Inside Caliper.	10 Nos.
7.	Dial Gauge with Magnetic Stand	10 Nos.
8.	Marking Gauge	10 Nos.
9.	Horizontal milling machine	1 No.
10.	Surface Grinding Machine	1 No.
11.	Tool and Cutter Grinder	1 No.
12.	Shaping Machine	1 No.

13.	CNC Turning centre	1 No.
14.	CNC Milling Centre	1 No.
15.	Tools and Measuring instruments	Sufficient quantity.
16.	Consumables	Sufficient quantity.
17.	Personal Computer	10 Nos.
18.	3D printer (Modelling and slicing software)	As per the requirement
19.	Laser/Inkjet Printer	1 No.

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

- All the exercises should be completed. All the exercise should be given for examinations, students can select any one exercise by lot, or the question paper supplied by the DOTE shall be used.
- Practical documents should be prepared, the same should be submitted for the End Semester Examinations along with the bonafide certificate.

DETAILED ALLOCATION OF MARKS

PART	DESCRIPTION	MARKS
A	Aim & Tools required	10
B	Preparation and Setting / Writing CNC Program / Modelling	30
C	Operation / Machining / Simulation / Slicing	30
D	Finish / Output	20
E	Viva Voce	10
	TOTAL MARKS	**100**

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

The primary objective of mechanical instrumentation is to provide fundamental principles of mechanical measurements. Working with mechanical instruments helps students develop practical skills such as measurement techniques, data acquisition, and analysis. This paves the way for them to design experiments, select appropriate instruments, interpret data, and draw conclusions. Through theoretical knowledge and experiments conducted in the lab, students can understand principles, applications, and importance of instruments used to measure, monitor, and control physical parameters in various fields of engineering, science, and industry. This equips students with essential knowledge and skills for tackling real-world challenges and contributing to advancements in technology and innovation.

Course Objectives

The objective of this course is to enable the student

- To understand the fundamental concepts of measurement.
- To understand the methods and principles of instrumentations of various systems.
- To understand different instruments and processes theoretically as well as experimentally.
- To apply the principles of instrumentation for transducers & measurement of parameters like temperature, pressure, flow, speed, force, and stress.
- To be familiar with various measuring instruments in industries.

Course Outcomes

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

CO1: Describe the concept of measurement and instrumentation.

CO2: Identify and select the appropriate instrument.

CO3: Measure, monitor, and control various parameters in engineering applications.

CO4: Evaluate the different measuring parameters.

CO5: Apply the learned concepts in the industries as well as use different instruments for measurements.

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites

Basic knowledge of measurements.

CO/PO Mapping

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

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

Instructional Strategy:

- To provide hands-on experience, promote active learning, and reinforce theoretical concepts.
- Start each lab session with demonstrations of the instruments and measurement techniques to be used.
- Connect lab activities with theoretical concepts covered in lectures or readings.
- Provide constructive feedback on students' performance and progress throughout the lab sessions.

1025234440	MECHANICAL INSTRUMENTATION	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
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.

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

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 observations, readings, calculations and sketches should be written by the student manually in the document.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook 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 / Preparation	10
B	Block Diagram, Reading and Graph	20
C	Execution of circuit	20
D	Practical Documents (As per the portions)	10
TOTAL MARKS		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 from the complete theory portions.	30 X 1 Mark	30 Marks
Part – B	Seven Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

- **CA4:** 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	Procedure / Preparation	10
B	Block Diagram, Reading and Graph	20
C	Execution of circuit	20
D	Output / Result	10
E	Viva voce	10
F	Written test	30
TOTAL MARKS		**100**

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

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

Syllabus contents

THEORY		
UNIT I	**INTRODUCTION TO INSTRUMENTS ; DISPLACEMENT, PRESSURE, TEMPERATURE AND FLOW MEASUREMENT.**	
Introduction to Instruments: Introduction - Classification of instruments - Static Characteristics - Dynamic Characteristics - Measurement of error - Classification of errors. Transducers - Classification of Transducers. Displacement Measurement: Capacitive transducer, Potentiometer LVDT, RVDT, Specification, Selection & application of displacement transducer. Pressure Measurement: Low pressure gauges- McLeod Gauge, Thermal conductivity gauge, Ionization gauge, High Pressure Gauge-Diaphragm, Bellows, Bourdon tube, piezoelectric type. Temperature Measurement: Non-electrical methods - Bimetal, Liquid in glass thermometer and Pressure thermometer. Electrical methods - Thermistor, Thermoelectric methods elements of thermocouple, law of Intermediate metals. Flow Measurements: Variable area meter - Rota meter, Variable velocity meter – Anemometer, Hot wire anemometer		9
Practical Exercises:		
Ex.No	**Name of the Experiment**	**Period**
1	Measure displacement by using inductive transducer. (Linear variable displacement transducer i.e. LVDT) and verify its characteristics.	4
2	Measure negative pressure or vacuum using McLeod gauge / Bourdon tube pressure gauge.	4
3	Measure temperature by thermocouple and verifying by thermometer.	4
4	Measure flow of liquid by rotameter.	4
UNIT II	**LIQUID LEVEL, SPEED, STRAIN AND FORCE MEASUREMENT**	
Liquid level measurement – direct and indirect methods. Speed measurement -Eddy current generation type tachometer, Mechanical Tachometers, Electrical - Inductive Pick Up, Capacitive Pick Up, Stroboscope.		6

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

Strain Measurement - Stress-strain relation, types of strain gauges, resistance strain gauge-bonded and unbonded, types. Torque Measurement.	

Practical Exercises:

Ex.No	Name of the Experiment	Period
5	Measure liquid level by capacitive transducer system.	4
6	Measure speed of rotating shaft by stroboscope	4
7	Measure speed of rotating shaft by inductive pick up.	4
8	Measure force or weight by load cell.	4
9	Measure strain by using basic strain gauge and verify the stress induced.	4
10	Measurement of Torque.	4
	Student activity + Assessment Test + Revision	20
	TOTAL HOURS	75

List of Students Activity to be performed:

(NOT FOR BOARD EXAMINATION- REPORT TO BE SUBMITTED)

- Find the static characteristics of instruments with demonstration of any two measuring instrument.

Reference

1. Mechanical Measurements &Control-D.S.Kumar-Metropolitan Publications, New Delhi.
2. Mechanical & Industrial Measurements-R.K.Jain-Khanna Publications, New Delhi
3. Mechanical Measurements &Instrumentation-A.K.Sawhney-Dhanpat Rai & Sons, New Delhi.
4. Measurement Systems-E. O. Doebelin-Tata McGraw Hill Publications.
5. Mechanical Measurement &Control-R.V. Jalgaonkar-Everest Publishing House, Pune.

Web-based/Online Resources

- NPTEL (Website): The National Programme on Technology Enhanced Learning (NPTEL) offers free online courses on Principles on Mechanical Measurement. NPTEL Mechanical Engineering. https://archive.nptel.ac.in/courses/112/103/112103261/

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

List of Equipments:

S.No.	Name of Equipments	Quantity
1.	Thermometer	2 Nos
2.	Temperature gauge / Temperature transducer	2 Nos
3.	Pressure measuring setup using McLeod gauge / Bourdon-tube pressure gauge.	2 Nos
4.	Strain measurement module using Strain gauge	2 Nos
5.	Displacement measurement module using LVDT	2 Nos
6.	3 wire RTD (PT-50 / PT-100) with industrial standard	2 Nos
7.	Thermocouple (J-type / K-type) with industrial standard	2 Nos
8.	Water bath with heater arrangement	2 Nos
9.	Furnace with blower arrangement	1 No.
10.	Load cell instruments and measurement setup	2 Nos
11.	Torsion meter/strain gauge torque transducers	2 Nos
12.	Capacitance transducers, water level trainer kit	2 Nos
13	Multi meter	2 Nos
14	DC Motor, photoelectric pick up kit, CRO connecting	2 Nos
15	Stroboscope	2 Nos

1025234440	MECHANICAL INSTRUMENTATION	L	T	P	C
PRACTICUM		1	0	4	3

Additional Instructions

- For the record of work done for practical exercises, record notebook / printed manual may be used. In this, the student should draw a diagram, and mention the readings/observations, calculations and result manually. The same should be submitted for the examinations with Bonafide Certificate.
- The proper safety procedure and norms should be followed with proper uniform with safety shoes during the practices.
- All the exercises should be completed before the Board Practical Examinations. Students will be permitted to select any one exercise by lot, or the question paper provided by the DOTE.

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

SCHEME OF EVALUATION

Part	Description	Marks
A	Procedure / Preparation	10
B	Block Diagram, Reading and Graph	20
C	Execution of circuit	20
D	Output / Result	10
E	Viva voce	10
F	Written test	30
TOTAL MARKS		**100**

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

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

INTRODUCTION:

Thermal engineering and automobile technology laboratory provides insights on the construction and working of IC engines. The students will also be introduced to the various governing laws of air standard cycles. The students will also be able to compute the various performance parameters of the IC engines. As production engineering students, they will be able to execute dismantling, servicing and assembling of various components that are associated with IC engines. Apart from this, the students will acquire essential knowledge of vapour compression refrigeration system.

COURSE OBJECTIVES:

- Identify various components, systems and subsystems of Diesel and petrol engines and to know the significance of the timing of valve and port opening in IC engines.
- Analyze the performance characteristics of single cylinder and multi cylinder internal combustion engines.
- To be able to know the significance of timely servicing of various parts and equipment associated with IC engines.
- To acquire knowledge about refrigeration system and compute the COP of vapour compression refrigeration system.

COURSE OUTCOMES:

CO1: Students will be able to understand the construction and working of IC engines.

CO2: Students will be able to dismantle, service and refit the various components / equipment of IC engine system.

CO3: Students should be able to differentiate between the working of petrol and diesel engines.

CO4: Students will be able to calculate the engine power, efficiency calculations various operating characteristics of two stroke and four stroke I.C Engines.

CO5: Students will be able to understand the concept of refrigeration and air conditioning.

Pre-requisites

Basic knowledge of laws governing physics and basic mathematical knowledge .

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping

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

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

Instructional Strategy:

- To develop a safe environment by inculcating the importance of safety among the students
- To introduce the theory concept prior to each exercise.
- To provide demonstration about the purpose of each equipment that is connected to the exercise / experiment. Provide a demo about conducting the exercise/experiment.
- To make students actively participate in the session by providing hands-on experience to conduct the experiment/exercise and reinforce theoretical concepts.
- Provide constructive feedback on students' performance and progress throughout the lab sessions.

1025234540	THERMAL ENGINEERING AND AUTOMOBILE 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 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
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.

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

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 observations, readings, calculations and sketches should be written by the student manually in the document.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook 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 and Procedure	10
B	Tabulation, Calculation and Diagram	20
C	Execution of the exercise	20
D	Practical Documents (As per the portions)	10
TOTAL MARKS		60

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

Cycle II: Exercises 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 from the complete theory portions.	30 X 1 Mark	30 Marks
Part – B	Seven Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

- **CA4:** 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 and Procedure	10
B	Tabulation, Calculation and Diagram	20
C	Execution of the exercise	20
D	Output / Result	10
E	Viva voce	10
F	Written test	30
TOTAL MARKS		**100**

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

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

SYLLABUS CONTENTS:

THEORY		
Unit I	**IC ENGINES -INTRODUCTION, WORKING AND PERFORMANCE**	**Hours**
1.1	**BASICS OF THERMODYNAMICS:** Definition- mass and weight – pressure – gauge and absolute pressure – temperature – absolute temperature – heat – specific heat – thermodynamic systems – properties of system – laws of thermodynamics – Zeroth law of thermodynamics – First law of thermodynamics – Second law of thermodynamics.	3
1.2	**PROPERTIES OF PERFECT GASES :** Introduction – Laws of perfect gases and its equations–Thermodynamics processes of perfect gases : Constant volume process – constant pressure process – isothermal process – adiabatic process – polytropic process - Equation of heat transfer, change of internal energy, change of entropy and Work done of various process	3
1.3	**AIR CYCLES :** Introduction – assumptions – classifications – efficiency of the cycle – reversible cycle – irreversible cycle – types of thermodynamic cycles – Carnot cycle –Otto cycle – Diesel cycle (Description only)	3
1.4	**IC ENGINES :** Introduction- classifications – four stroke cycle petrol and diesel engines- two stroke cycle – petrol and diesel engines – comparison - valve timing and port timing diagram Performance of IC Engines : Performance of I.C engines - indicated power - brake power - friction power efficiencies of I.C engines- indicated thermal, brake thermal, mechanical and relative efficiencies - Morse test- procedure - problems.	3

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

PRACTICAL EXERCISES		
Ex.No	**NAME OF THE EXERCISE / EXPERIMENT**	**HOURS**
1.	Draw a port timing diagram of two stroke petrol / diesel engine	4
2.	Draw a valve timing diagram of four stroke petrol engine	4
3.	Draw a valve timing diagram of four stroke diesel engine	4
4.	Conduct the performance test on Petrol / Diesel engine and draw the performance curves.	4
5.	Conduct a Morse test on multi cylinder Petrol engine / Diesel engine.	4
Unit II	**IC ENGINES COMPONENTS AND INTRODUCTION TO REFRIGERATION SYSTEM**	
2.1	**CONSTRUCTION OF IC ENGINES -** Components of Cylinder Assembly - Carburetor - Fuel injection system - Fuel Injector - CRDI System - MPFI System- Various Pumps	4
2.2	**REFRIGERATION** – definitions – refrigerating effect- unit of refrigeration – COP- Refrigerators and heat pumps - types and applications of refrigeration - Vapour Compression Refrigeration System.	4
PRACTICAL EXERCISES		
Ex.No	**NAME OF THE EXERCISE / EXPERIMENT**	**HOURS**
6.	Dismantling, servicing and assembling a two stroke or four stroke IC engine cylinder assembly.	4
7.	Removing, servicing and replacing fuel pump or oil pump or water pump and study the working of the pump.	4
8.	Dismantling, servicing and assembling of SOLEX or SU carburetors and study the working of the carburetor.	4
9.	Dismantling and assembling of fuel injector and study of components in CRDI/MPFI.	4
10.	Find the Coefficient of Performance of Vapour Compression Refrigeration System.	4
	Students Activity + Continuous Assessment Test	15
	TOTAL HOURS	**75**

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

List of student activity to be performed:

1. For different compression ratios (at least 3) and with all other parameters remaining same the student may calculate the efficiency of the engine. A graph showing compression ratio vs efficiency can be plotted.
2. Compare isothermal and isentropic process and plot a graph for a gas that is expanded from a initial pressure and volume to final pressure and volume. The mass of the gas shall remain same in both the process.

REFERENCES:

1. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
2. V.Ganesan, "Internal Combustion Engines" Mcgraw-hill Education, 4th Edition, 2017.
3. Rathakrishnan E., "Fundamentals of Engineering Thermodynamics" Prentice-Hall India, 2005.
4. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
5. R. K. Rajput," Applied Thermodynamics" Laxmi Publications, Ltd., 2009
6. Holman. J. P., "Thermodynamics", 3rd Ed. McGraw-Hill, 2007.
7. B.K.Sarkar, "Thermal Engineering"McGraw-Hill Education (India) pvt ltd, 2001
8. Yunus A. Cengel , Michael A. Boles , Mehmet Kanoglu "Thermodynamics: An Engineering Approach", 9th Edition, Mcgraw-Hill

WEBSITES:

1. https://www.britannica.com/technology
2. https://learnmech.com
3. https://archive.nptel.ac.in/courses/112/103/112103316

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

LIST OF EQUIPMENTS:

Sl.No	Name of the Equipment	Quantity
1.	Basic and special tools.	**Sufficient quantity.**
2.	Model for Port timing diagram	**1 no**
3.	Model for Valve timing diagram(diesel and petrol engine)	**1 each**
4.	Petrol engine/ Diesel engine test rig to conduct load test	**1 No**
5.	Multi cylinder Petrol engine test rig to conduct Morse test.	**1 No**
6.	Two stroke / Four stroke IC engine cylinder assembly	**1 No**
7.	SOLEX carburetor / SU carburetor	**1 No**
8.	MPFI system / CRDI system	**1 No**
9.	Fuel injector	**1 No**
10.	Fuel pump or Oil pump or Water pump	**1 No**
11.	Test rig for finding COP of refrigerator.	**1 No**

1025234540	THERMAL ENGINEERING AND AUTOMOBILE TECHNOLOGY	L	T	P	C
PRACTICUM		1	0	4	3

END SEMESTER EXAMINATIONS – 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 record of work done by the student should be submitted with a Bonafide Certificate.

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim and Procedure	10
B	Tabulation, Calculation and Diagram	20
C	Execution of the exercise	20
D	Output / Result	10
E	Viva voce	10
F	Written test	30
TOTAL MARKS		**100**

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

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

Hydraulics and pneumatics are critical components in modern engineering, playing a vital role in the operation of machinery and equipment across various industries. This practical course introduces students to the fundamental principles and applications of hydraulic and pneumatic systems. Through hands-on experiments and exercises, students will explore the behavior of fluids under pressure, the operation of hydraulic and pneumatic circuits, and the functionality of key components such as pumps, valves, actuators, and compressors. By the end of the course, students will gain practical skills in designing, analyzing, and troubleshooting hydraulic and pneumatic systems, preparing them for real-world engineering challenges in fields such as manufacturing, automation, and robotics.

Course Objectives

The objective of this course is to enable the student to

- Understand the various components of hydraulic and pneumatic systems.
- Design basic hydraulic circuits to actuate hydraulic motors and cylinders.
- Design basic pneumatic circuits to actuate pneumatic cylinder.
- Develop basic PLC programs to control pneumatic cylinders using PLC kit.
- Operate hydraulic and pneumatic systems using basic circuits and PLC programs.

Course Outcomes

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

CO1: Discuss the various components of hydraulic and pneumatic systems.
CO2: Construct the circuit and observe the behavior of hydraulic motor and cylinder.
CO3: Demonstrate the use of PLC kit in controlling hydraulic system using basic PLC program.
CO4: Construct the circuit and observe the behavior of pneumatic cylinders.
CO5: Demonstrate the use of PLC kit in controlling pneumatic system using basic PLC program.

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites

Applied Physics, Basic Electrical and Mechanical Engineering.

CO/PO Mapping

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

Legend:3-HighCorrelation,2-MediumCorrelation,1-LowCorrelation

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.

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	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
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.

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

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 observations, readings, calculations and sketches should be written by the student manually in the document.

The detailed date of the practices and its evaluations should be maintained in the course logbook. The logbook 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 / Preparation	10
B	Circuit Diagram	20
C	Connections / Execution	20
D	Practical Documents (As per the portions)	10
TOTAL MARKS		**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 from the complete theory portions.	30 X 1 Mark	30 Marks
Part – B	Seven Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			**100 Marks**

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

- **CA4:** 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	Procedure / Preparation	10
B	Circuit Diagram	20
C	Connections / Execution	20
D	Output / Result	10
E	Viva voce	10
F	Written test	30
TOTAL MARKS		**100**

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

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

Syllabus Contents

THEORY	
UNIT I: HYDRAULICS	**Period**
Introduction to Fluid Power Systems: Fluid power systems - general layout - components of hydraulic & pneumatic systems - practical applications of Fluid power systems - comparison - advantages and limitations - safety protocols in hydraulic & pneumatic systems. Components of Hydraulic Systems: Types, construction, working principle and symbol of the following components. Pump – vane, gear and piston pumps. Valves: Pressure Control valves – pressure relief valve, pressure reducing valve, pressure unloading valve. Direction control valve – poppet valve, spool valve, 3/2, 4/2 & 4/3 DC valves, sequencing valve. Flow control valve – pressure compensated – non pressure compensated. Actuators – linear actuators – single acting & double acting cylinders – rotary actuators – hydraulic motors. Accessories – intensifiers and accumulators. Hydraulic Circuits: Double acting cylinder with meter in, meter out circuits, sequencing circuit. Hydraulic circuits for milling machine, shaping machine.	**8**

Practical Exercises:

Ex.No	Name of the Experiment	Period
1.	OBSERVE THE BEHAVIOUR OF HYDRAULIC MOTOR Activities to Perform: i) Construct a hydraulic circuit to control hydraulic motor. ii) Observe the behaviour of hydraulic motor.	**4**

2.	OBSERVE THE BEHAVIOUR OF DOUBLE ACTING HYDRAULIC CYLINDER Activities to Perform: i) Construct a hydraulic circuit to control double acting cylinder. ii) Observe the behaviour of double acting cylinder.	**4**
3.	SPEED CONTROL OF DOUBLE ACTING HYDRAULIC CYLINDER USING METER-IN AND METER-OUT CIRCUIT Activities to Perform: i) Construct a meter-in and meter-out circuit to control the speed of double acting hydraulic cylinder. ii) Discuss the behaviour of cylinder as linear actuator.	**4**
4.	AUTOMATIC OPERATION (MULTI CYCLE) OF A DOUBLE ACTING HYDRAULIC CYLINDER USING PLC KIT Activities to Perform: i) Construct a hydraulic circuit to automatically operate a double acting cylinder using PLC kit. ii) Discuss the behaviour of cylinder as linear actuator.	**4**
5.	SEQUENTIAL OPERATION OF A DOUBLE ACTING HYDRAULIC CYLINDER AND A MOTOR USING PLC KIT Activities to Perform: i) Construct a hydraulic circuit to sequentially operate a double acting cylinder and a motor using PLC kit. ii) Discuss the behaviour of cylinder and motor.	**4**

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

UNIT II: PNEUMATICS	
Components of pneumatic systems: Types, construction, working Principle and symbol of the following components. Compressor – Reciprocating & Rotary Compressors. Valves: Pressure Control valves – pressure relief valve, pressure regulating valves. Direction control valves – 3/2, 5/2 & 5/3 DC valves, sequencing valve. Flow control valve – throttle valves – shuttle valves quick exhaust valves. Actuators – Linear actuators – single acting & double acting cylinders – rotary actuators – air motors. Accessories - FRL unit. Pneumatic Circuits: Double acting cylinder with meter in, meter out circuits, speed control circuit and sequencing circuit.	**7**

Practical Exercises:

Ex.No	**Name of the Experiment**	**Period**
6.	OBSERVE THE BEHAVIOUR OF SINGLE ACTING AND DOUBLE ACTING PNEUMATIC CYLINDER Activities to Perform: i) Construct a pneumatic circuit to control single acting and double acting cylinder. ii) Observe the behaviour of single acting and double acting cylinder.	**4**
7.	SPEED CONTROL OF DOUBLE ACTING PNEUMATIC CYLINDER USING METER-IN AND METER-OUT CIRCUIT Activities to Perform: i) Construct a meter-in and meter-out circuit to control the speed of double acting pneumatic cylinder. ii) Discuss the behaviour of double acting cylinder.	**4**

8.	AUTOMATIC OPERATION (SINGLE CYCLE) OF A DOUBLE ACTING PNEUMATIC CYLINDER USING LIMIT SWITCH Activities to Perform: i) Construct a pneumatic circuit to automatically operate (single cycle) a double acting cylinder using limit switch. ii) Discuss the behaviour of cylinder as linear actuator.	**4**
9.	AUTOMATIC OPERATION (MULTI CYCLE) OF A DOUBLE ACTING PNEUMATIC CYLINDER USING PLC KIT Activities to Perform: i) Construct a pneumatic circuit to automatically operate a double acting cylinder using PLC kit. ii) Discuss the behaviour of cylinder as linear actuator.	**4**
10.	SEQUENTIAL OPERATION OF A DOUBLE ACTING PNEUMATIC CYLINDER AND A MOTOR USING PLC KIT Activities to Perform: i) Construct a pneumatic circuit to sequentially operate a double acting cylinder and a motor using PLC kit. ii) Discuss the behaviour of cylinder and motor.	**4**
	Assessment Test + Revision + Students Activity	**20**
	Total Period	**75**

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

Activity 1: Each student to write and submit an assignment on the topic 'Basics of Hydraulics and Pneumatics'.

Activity 2: Four students can be grouped as a batch and practice an additional experiment of designing a hydraulic or pneumatic circuit to control two cylinders synchronously.

Text and Reference Books:

1. "Fluid Power with Applications", Anthony Esposito, Pearson Prentice Hall, New Delhi, 2018.
2. "Oil Hydraulics Systems- Principles and Maintenance", Majumdar S.R., Tata McGraw- Hill, New Delhi, 2017.
3. "Pneumatic Systems: Principles and Maintenance" Majumdar S.R., Tata McGraw- Hill, New Delhi, 2017.
4. "Hydraulic and Pneumatic Controls", Shanmugasundaram. K, Chand & Co, 2006.
5. "Fluid Power: Theory and Applications", James Sullivan, 4th Edition, Prentice Hall, New Jersey, 1997.
6. "Basic Fluid Power", Dudelyt, A Pease and John J Pippenger, Prentice Hall, 1987.
7. "Hydraulic and Pneumatic Controls", Srinivasan.R, Vijay Nicole Imprints, 2008.

Web-based/Online Resources:

- https://youtu.be/-SQvrrzIAac?list=PLIMdd_mE4yZGWJ32cgnK2-bs44Gpj81xi
- https://youtu.be/OcsXgw5N10U?list=PLbMVogVj5nJTKwm1WjlutrAEZrLE995Ja
- https://youtu.be/qSmNlSwL5pk
- https://youtu.be/I22svIVXYaY
- https://youtu.be/zsajTNtxfAE

Equipment / Facilities required to conduct the Practical Course.

1025234640	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
PRACTICUM		1	0	4	3

S. No	Name of the Equipment's	Quantity Required
1.	Hydraulics Trainer Kit (All Cylinders, Control Valves, Limit switches and other accessories)	3 Nos
2.	Pneumatic Trainer Kit (All Cylinders, Control Valves, Limit switches and other accessories)	3 Nos
3.	PLC Trainer Kit	2 Nos
4.	Computer with software	4 Nos
5.	Other Consumables	As Required

END SEMESTER EXAMINATIONS – 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 record of work done by the student should be submitted with a Bonafide Certificate.

SCHEME OF EVALUATION

Part	Description	Marks
A	Procedure / Preparation	10
B	Circuit Diagram	20
C	Connections / Execution	20
D	Output / Result	10
E	Viva voce	10
F	Written Test	30
TOTALMARKS		**100**

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

1020235110	ELEMENTS OF MACHINE DESIGN	L	T	P	C
THEORY		3	0	0	3

Introduction

Design plays a major role in developing engineering and technology. Machine Design is the creationof new and better machines and improving the existing ones. Elements Design is the process of selection of the material, shape, size and arrangement of mechanical elements so that the machine will perform its task. A process which includes design of all parts of a machine subjected to carry the forces without failure by transforming other forms of energy into mechanical energy.

Course Objectives

The objective of this course is to enable the student to apply the various design procedures, principles and various stresses in the elements of machine design.

1. To understand and apply to Solve the problems of various types of failures, and design of joints.
2. To apply the Design procedure of keys and coupling.
3. To apply the Design procedure of belt drives and selection of belt drives.
4. To apply the design procedure of supported rotating element.
5. To understand the concept of Computer Aided Design.

Course Outcome

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

CO1: Calculate the dimensions of shaft and key for a given application

CO2: Design a coupling for a given application.

CO3:Select proper belt drive from manufacturers catalogue for power transmission under specified condition

CO4: Design journal bearing, and spur gear based on a given applications

CO5: Practice the CAD activities in various stages of product design

Prerequisites

Mathematics, Engineering Mechanics, Strength of Materials, and Engineering Drawing.

1020235110	ELEMENTS OF MACHINE DESIGN	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	40	40	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 40 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 Two questions (2 X 20 Marks = 40 Marks).

Four questions will be asked, students should write Two questions. Each unit Two 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.

1020235110	ELEMENTS OF MACHINE DESIGN	L	T	P	C
THEORY		3	0	0	3

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 Five questions by selecting One question from each unit. Each question carries 20 marks each.

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

CO-PO Mapping

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

1020235110	ELEMENTS OF MACHINE DESIGN	L	T	P	C
THEORY		3	0	0	3

Syllabus Contents.

THEORY		
Unit I	**Fundamentals of Design and Stresses**	
Introduction about Component Design. Engineering materials - Factors affecting selection of materials BIS designation of Ferrous materials – Preferred number - Factor of safety and allowable stress - Stresses: Tension, Compression, Shear, bearing pressure intensity, crushing, bending and torsion- Problem. Composite Material, types, property and applications. Creep strain and Creep Curve- Fatigue, S-N curve, Endurance Limit Stress Concentration. Theories of Elastic Failures Principal normal stress theory, Maximum shear stress theory & Maximum distortion energy theory.		8
Unit II	**Design Of Coupling and Keys**	
Couplings, Requirements of good couplings, types – design of rigid protected type flange couplings marine coupling pin type flexible couplings (description only). Keys - Types of keys - design of sunk keys only - Effect of keyways on shaft - problems.		9
Unit III	**Design of Flat Belts and V-Belts**	
Flat Belts: Types of belts - materials for belt - types of belt drives - Speed ratio - effect of slip - length of flat belts -Tension Ratio. centrifugal tension - power transmitted - condition for maximum power - transmission - Initial Tension - Design procedure of flat belts - Design of flat belt based on manufacturer's data only – problems. V-belt drive - comparison with flat belt drive - designation of V belts - length of belt - power transmitted - Design of V-belt using manufacturer's data only - Problem.		10

1020235110	ELEMENTS OF MACHINE DESIGN	L	T	P	C
THEORY		3	0	0	3

Unit IV	Design of Bearings	
Bearings: Classifications of bearings - sliding contact and rolling contact bearings - radial and thrust bearings - roller bearing – types. Designation of ball bearings - materials used for bearings - design of journal bearings heat generated, heat dissipated, cooling oil requirement - Problems. Design of journal bearings problems, design based on approved date book only. (No problem from dimensionless parameters)		9
Unit V	**Computer Aided Design (CAD) and Geometric Modelling**	
CAD – Roles of CAD in design - Development and uses – applications, advantages, Product life cycle. Design process: Sequential Engineering – Concurrent Engineering, Value Engineering, Lean Manufacturing System. Geometric modelling, Solid modelling representation in CAD, Solid modelling approaches, Constructive Solid Geometry, Boundary representation - Comparison - Finite Element analysis - Prototype. (New Product Development technique)		9

NOTE: Printed approved Design Data Books are permitted for all examinations / Approved data books abstract copy attested by the HOD and Principal can be used.

Suggested list of Students Activity

1. Online MCQ shall be conducted for each unit.
2. Presentation and Seminar can be conducted.
3. Seminars about the product development process can be given.
4. Simulation practices of design and analysis can be given.

1020235110	ELEMENTS OF MACHINE DESIGN	L	T	P	C
THEORY		3	0	0	3

Reference Books

1. Machine Design, Pandya & Shah,20th Edn. 2015, Charotar Publishing House.
2. Machine Design, T. V. Sundararajamoorthy & N. Shanmugam, Revised Edition June-2018–Anuradha Publications.
3. Design Data Book – by PSG College of Technology, DPV Printers.
4. A textbook of Machine Design, R.S. Khurmi & J.K.Gupta, Edn. 18,2005, S. Chand Publishing.
5. Design of Machine Elements, Bandari, 4th Edition 2016, Tata McGraw-Hill , New Delhi.
6. Mechanics of Composite Materials, Second Edition, 2006 Autar K. Kaw, Taylor & Francis Group.
7. "R.Radhakrishnan, and S.Subramanian, "CAD/CAM/CIM"2018, New Age International Pvt Limited.

Web Reference

- https://nptel.ac.in/courses/112/105/112105125/
- https://nptel.ac.in/courses/112/105/112105124/
- https://nptel.ac.in/courses/112/106/112106137/

END SEMESTER QUESTION PATTERN – Theory Exam,

DURATION: 3 Hrs. **Max. Marks : 100**

Question Pattern:

Answer Five questions by selecting One question from each unit. Each question carries 20 marks each. Printed Design Data Book and Approved abstract of the Data Book can be permitted.

Instruction to Question setters.

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

1020235230	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
PRACTICUM		3	0	2	4

Introduction

In the Indian Economy, Industries and enterprises always find a prominent place. After globalization, the government of India has announced a liberalization policy of starting an enterprise which resulted in the mushroom growth of industries. The present day students should be trained not only in manufacturing processes but also in managing activities of industries. Training must be imparted to students not only to shape them as technicians but also as good managers. The knowledge about plant, safety, work study techniques, personnel management and financial management will definitely mould the students as managers to suitthe industries. Due to the presence of such personalities the industries will leap for better prosperity and development.

Course Objectives

The objective of this course is to enable the student to

- To study the different types of layout.
- To study the safety aspects and its impacts on an organization.
- To study different work measurement techniques.
- To study the staff selection procedure and training of them.
- To study capital and resources of capital.
- To study inventory control systems.
- To study engineering ethics and human values.

Course Outcomes

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

CO1: Select the plant layout by incorporating plant safety procedure

CO2: Apply work study principles as a tool for plant management

CO3: Describe the principles of management used in industries

CO4: Apply various inventory control techniques in material management

CO5: Describe modern management techniques used in shop floor

.

1020235230	**INDUSTRIAL ENGINEERING AND MANAGEMENT**	L	T	P	C
PRACTICUM		3	0	2	4

Pre-requisites

Basic knowledge of industries and its practices (through Industrial Visits)

CO/PO Mapping

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

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

Instructional Strategy

- Conduct group discussions on plant safety
- Encourage students to know about the share market details(BSE,NSE)
- Use PowerPoint presentations.

1020235230	**INDUSTRIAL ENGINEERING AND MANAGEMENT**	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 Periods	2 Periods	3 Hours	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. Answer any 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.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks will be converted to 15 Marks for the internal mark.

1020235230	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
PRACTICUM		3	0	2	4

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 practical documents to be prepared as per the instruction below.

Each exercise procedure and steps 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 reading and calculations and graph should be written by the student manually in the document.

The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim	10
B	Procedure / Steps	20
C	Explanation	20
D	Report	10
E	Practical document (All Practicals)	30
F	Viva Voce	10
	Total	100

1020235230	**INDUSTRIAL ENGINEERING AND MANAGEMENT**	L	T	P	C
PRACTICUM		3	0	2	4

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.

Syllabus Contents.

THEORY PORTION

Unit I	**PLANT ENGINEERING AND PLANT SAFETY**	
Plant Engineering : Plant – Selection of site of industry – Plant layout – types – process, product and fixed position – Plant maintenance – importance – Break down maintenance, preventive maintenance and scheduled maintenance. Plant Safety: Importance – Industrial safety and procedure-Improper handling-accident - causes and cost of an accident - accident proneness - prevention of accidents-Settlement of industrial disputes - Indian Factories Act 1948 and its provisions related to health, welfare and safety.		9
Unit II	**METHOD STUDY AND WORK MEASUREMENT**	
Method Study: Definition – Ergonomics-Basic procedure for conduct of method study – Tools used – Operation process chart, Flow process chart, two handed process chart- Man machine chart. Work Measurement: Definition – Basic procedure in making a time study – Cycle time and Total Time-Techniques of work measurement - Ratio delay study, Synthesis from standard data, analytical estimating, Predetermined Motion Time System(PMTS).		9

1020235230	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
PRACTICUM		3	0	2	4

Unit III	PRINCIPLES OF MANAGEMENT	
Principles of Management: Definition of management – Administration - Organization – F.W. Taylor's and Henry Fayol's Principles of Management - Selection procedure – Training of workers – Apprentice training – On the job training and vestibule school training - wages and salary administration – Components of wages.		9
Unit IV	**FINANCIAL AND MATERIAL MANAGEMENT**	
Financial Management: Resources of capital – shares-preference and equity shares – debentures-Factory costing – direct cost – indirect cost – Factory overhead – Selling price of a product – Profit –. Depreciation – Causes –Methods -Straight line, sinking fund and percentage on diminishing value method Material Management: Objectives of good stock control system – ABC analysis of inventory – Procurement and consumption cycle – Minimum Stock, Lead Time, Reorder Level - Economic order quantity – problems –Supply chain Management - Purchasing Procedure- Bin card.		9
Unit V	**MODERN MANAGEMENT TECHNIQUES**	
5S concept - Just in Time(JIT) - Kaizen - ERP - Kanban - SQC - SPC - PPC - TPM -TQM - Quality tools - 7QC Tools - PDCA Cycle Six sigma - Industry 4.0 – Internet of things(IoT) - Cloud computing - AI and Machine Learning-Management Information System(MIS).		9
	Theory Portions	45
	Practical	20
	Practice + Revision + Test	10
	Total	75

1020235230	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
PRACTICUM		3	0	2	4

PRACTICAL EXERCISES **20 Periods**

1. **TO STUDY AND PREPARE OPERATION PROCESS CHART (OPC)FOR GIVEN ASSEMBLYAND SITUATION.**

   Assemble a Pedestal Electric Fan With Following Parts

   - Base,
   - pedestal ,
   - motor head ,
   - switch set,
   - rear guard,
   - front guard,
   - guard ring lock,
   - blade,
   - screws

2. **To Study & Prepare Flow Process Chart (FPC) for the given assembly.**

   Construct a Flow Process Chart for the following:

   - Move bar stock from store to hacksaw Dist. 8 meter
   - Cutting of bar stock Time 4 min
   - Move to lathe machine Dist. 6-meter
   - Turning Process Time 5 min
   - Move to milling machine Dist. 7-meter
   - Wait for milling machine Time 2 min
   - Milling keyway Time 10 min

3. **To study & Prepare Man-Machine (Multiple Activity) Chart for the given situation**

   A chamfering, turning and threading operation is done on a job on lathe machine. Information of that operation is recorded as under. Show this information on man and machine chart.

   - Carry bar stock from the store. 1 min
   - To fix the job in lathe chuck. 2 min
   - To carryout manual turning of the job. 1.5 min

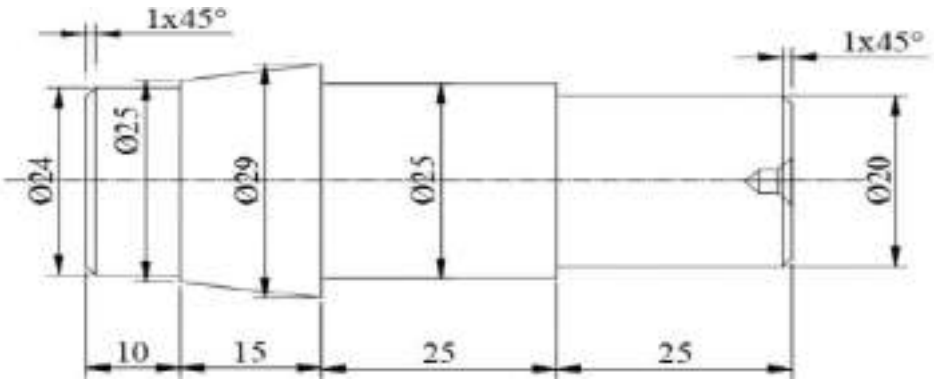
- To carryout chamfering operation on job 1 min
- To carry out threading operations on the job. 2 min
- To bring the saddle back and rearrange it 0.5 min
- To carry out threading work on the job. 1.5 min
- Inspection of the job. 1 min
- To remove the job from the lathe chuck. 0.5 min
- Carrying completed work piece to store 1 min

4. **To study & Calculate coefficient of correlation for time study person using performance rating technique.**

Find actual rating using basic time. Plot a graph of actual rating v/s observed rating.

- At a time one student will walk a distance of 25 feet in a normal way.
- Another student (time-keeper) will note down the time taken for that student to walk.
- All the remaining students will assign ratings to the student walking in the observation table.
- Time-keeper will give time for that student to all the students.
- Repeat the same procedure changing the time-keeper and the student walking
- Find basic time using observations.

5. **To study & Calculate standard time for the given job.**



Basic time = Observed time × Rating of worker /Standard Rating **Work Content= Basic time + Relaxation & Incidental Allowances**

Standard Time= Work Content + Other Allowances

6. To Draw Two Handed Process Chart For Bolt, Washer & Nut Assembly

To draw left and right hand process charts and to conduct time study for the bolt, washer & nut assembly of present and improved methods.

$$\%\, TIME\ SAVED = \frac{AVERAGE\ TIME\ TAKEN\ FOR\ AN\ ASSEMBLY\ OLD\ METHOD - AVERAGE\ TIME\ TAKEN\ FOR\ AN\ ASSEMBLY\ NEW\ METHOD}{AVERAGE\ TIME\ TAKEN\ FOR\ AN\ ASSEMBLY\ OLD\ METHOD}$$

APPARATUS REQUIRED:

1. Stopwatch
2. Brass spindles
3. Nylon washers
4. Lock washers
5. Hexagonal nuts

Suggested List of Students Activity

Presentation/seminars by the students on modern management techniques.Explore various plants during industrial visits.

Find the selling price of a product using ladder diagrams.

Find depreciation values of vehicles.

Find standard time for a particular job (in lathe) using stopwatch time study methods.

Reference

1. S.C.Sharma & T.R. Banga, Industrial Engineering and Management, 2nd Edition, Khanna Book Publishing, 2022.
2. S.Chand, Industrial Engineering and Production Management, 3rd Edition, S. Chand Publishing, 2018.
3. M.P.Poonia & S.C.Sharma, Industrial Safety and Maintenance Management,1 st Edition, Khanna Publishing, 2021.

1020235230	INDUSTRIAL ENGINEERING AND MANAGEMENT	L	T	P	C
PRACTICUM		3	0	2	4

Web-based Online Resources

- https://youtu.be/jFDWlKayrTc?si=oe4glWk9Qb18wxUx
- https://youtu.be/yhywrCChJBQ?si=7eXkcTyAsH8TNP6x

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.

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

Introduction

Quality Control (QC) is a critical aspect of manufacturing and service industries, ensuring that products and services meet predefined standards and customer expectations. Over the years, QC has evolved significantly, incorporating advanced techniques and tools to improve efficiency, accuracy, and reliability. Modern Quality Control tools are a combination of traditional methodologies and innovative technologies designed to enhance the quality management process.

Course Objectives

The objectives of this course is enable the student to

- Explain the basic Quality concepts and its objectives.
- Explain the Total Quality Management Principles.
- To learn the concept and properties of various Continuous improvement methods.
- Appreciate the benefits of implementing 5S , Kaizen concepts.
- Collect and classify various data.
- Determine the process capability of a manufacturing process through the constructionof various control charts for variables and attributes.
- Knowledge and practice on construction of Quality and Management tools.

Course Outcomes

On successful completion of this course, the student able to

CO1: Explain the Quality concepts and techniques used in industries.

CO2: Acquire knowledge about various continuous improvement methods and its implementation techniques.

CO3: Interpret types of data on various control charts for improving the process.

CO4: Create QC charts using Seven tools of quality for problem solving and continuous improvement processes.

CO5: Adopt the seven management tools to identify improvement opportunities and developimplementation plans.

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

Pre-requisites

Knowledge of basic Science

CO/PO Mapping

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

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

Instructional Strategy

Active Learning: Activities for active learning can include think-pair-share strategies as well askin-esthetic learning environment. Teachers can start a discussion to make sure students take ownership over their own participation and talk through new ideas and skills with peers. Teachers guide students as they construct their own knowledge and understanding.

Hands-on-Training: Conduct demonstrations and hands on training is all about applying the knowledge you have learned in training into practice.

Real time Learning: Instructors shall encourage the students to implement the techniques in their own place / Lab through the Industry-Institute interactions.

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test 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 Periods	2 Periods	3 Hours	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. Answer any 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.

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The

practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical documents to be prepared as per the instruction below. Each experiment procedure and steps should be completed on the day of practice. Thesame 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 reading and calculations and graph should be written by the student manually in the documents.

The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Description	10
B	Procedure	20
C	Presentation	30
D	Practical document (All Practicals)	30
E	Viva Voice	10
	Total	**100**

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

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.

Syllabus Contents.

Unit I	**BASICS OF QUALITY CONCEPTS**	
Definitions of the terms – Inspection, Quality, Quality Planning , Quality Control , Quality Assurance , Quality Management - Dimensions of quality –Basics of Total Quality– Quality Statements – Strategic Planning – Evolution of Quality Management – Quality Awards - Introduction to TQM – Pillars of TQM - Characteristics – Basic concepts – Quality Objectives – Team Building - Barriers to TQM implementation – Potential benefits of TQM – Quality council – Duties – Responsibilities –Strategic planning – Factors influencing Quality Costs - Customer Focus – Employee Involvement		6
Unit II	**CONTINUOUS PROCESS IMPROVEMENT**	
Input / Output process model – Juran Trilogy – PDCA (Deming Wheel) cycle – 5S Concepts – SEIRI, SEITON, SEISO, SEIKETSU and SHITSUKE – needs and objectives – effective implementation of 5S concepts in an organisation – Kaizen – Gemba Kaizen – Housekeeping- Quality Circles and the Trade Unions – Reengineering - Characteristics– Advantages -Criticism of Reengineering-Supplier relationship		6
Unit III	**STATISTICAL PROCESS CONTROL**	

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

Definition – Statistics Data- definition , types and uses. Measures of general Tendency and Dispersion – Mean – Median – Mode –Introduction to measures of dispersion – Population and Sample – Statistical Process Control and SQC definition– Process Capability – Sampling -Control Charts and its types – Comparison of Variable and attributes – X bar and R (Problems) , Attributes – p , np and c Charts.-Process capability analysis , Definition, steps and its uses.		6
Unit IV	**SEVEN TOOLS OF QUALITY**	
Seven tools of quality (Q-7 tools) – Check sheet – Histogram – Cause and effect diagram - Pareto diagram – Scatter diagram - Flow charts – Control charts - Construction of above tools , types , Uses and Limitations		6
Unit V	**NEW SEVEN MANAGEMENT TOOLS , QUALITY MANAGEMENT SYSTEMS**	
New seven management tools- Flow and its uses - Affinity diagram – Interrelationship digraph or Relationship diagram - Tree diagram - Matrix Diagram-Prioritization matrices – Process decision program chart – Activity networkdiagram. -Construction of above diagrams. Six sigma –Objectives , Methodology and Benefits – DMAIC -Quality Management System – ISO 9000 , ISO 14000 Documentation and Implementation – Total Productive Maintenance –Concepts and Needs.		6
	Theory portions	**30**
	Practical Exercise	**20**
	Revision + Test	**10**
	Total	**60**

PRACTICAL EXERCISE

1. The Six Sigma process typically follows the DMAIC framework: Define, Measure, Analyze, Improve, and Control.
2. Write the detailed steps for Lean Manufacturing.
3. Explain the statistical methods to monitor and control a process in SPC.

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

4. Write steps to practice kaizen.
5. Write the procedure to followed for Failure Mode and Effects Analysis (FMEA)
6. Write the step by procedure for the RCA method of problem-solving.
7. Implement 5S on the shop floor and document the details.
8. Create the SPC for the dataset. Use control charts
9. Carry out the Root Cause Analysis (RCA) for the sample
10. Carry out Pareto Analysis. and document the finding.

Suggested List of Students Activity

Quality Audits and Inspections:

- Participating in regular quality audits and inspections of manufacturing processes and products.
- Learning to use inspection tools and techniques to identify defects and ensure compliance with quality standards.
- Documenting findings and suggesting improvements to enhance product quality.

Statistical Process Control (SPC) Projects:

- Using SPC tools to monitor and control manufacturing processes.
- Collecting and analyzing data to identify trends, variations, and potential issues.
- Implementing corrective actions based on data analysis to maintain consistent product quality.

Root Cause Analysis (RCA) and Problem-Solving Activities:

- Engaging in RCA to investigate quality issues and determine their underlying causes.
- Using problem-solving methodologies such as the 5 Whys, Fishbone Diagrams, andFailure Mode and Effects Analysis (FMEA).
- Developing and implementing action plans to prevent recurrence of quality issues.

Lean Manufacturing and Continuous Improvement Initiatives:

- Participating in Lean Manufacturing activities to eliminate waste and improve efficiency.
- Engaging in continuous improvement projects such as Kaizen events, 5S implementation, and value stream mapping.

1020235331	MODERN QC TOOLS	L	T	P	C
PRACTICUM		2	0	2	3

- Contributing to the development of standard operating procedures (SOPs) and best practices to sustain high-quality standards.

Reference

1. "Quality Control and Total Quality Management" by P.L. Jain, Tata McGraw Hill Education.
2. "Total Quality Management" by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield, Mary Besterfield-Sacre, Pearson Education.
3. "Statistical Quality Control" by Eugene L. Grant, Richard S. Leavenworth, Tata McGraw Hill Education.
4. "Total Quality Management: Principles and Practice" by S. K. Mandal, Vikas Publishing House.
5. "Six Sigma for Business Excellence: Approach, Tools and Applications" by Hemant Urdhwareshe, Pearson Education
6. "Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, Second Edition" by Piotr Konieczka, Jacek Namieśnik, CRC Press (Distributed in India).

END SEMESTER EXAMINATION 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.

1020235332	COMPOSITE MATERIALS	L	T	P	C
PRACTICUM		2	0	2	3

Introduction

The field of composite materials has seen significant advancements. The development of new composite manufacturing techniques has made it feasible to modify the characteristics of traditional materials to meet specifications. Diploma holders in this course are required to make use of different composite materials and its manufacturing techniques for different end use applications. To do this, it is essential to instruct them on the fundamentals of metal matrix composites, ceramic composites, polymer matrix composites, and more modern advanced composites, as well as their properties, production methods, and mechanical testing applications. This course seeks to increase understanding of the several types of composite materials used in industries, including their types, testing, and applications.

Course Objectives

The objective of this course is to prepare the student.

- To understand the types of composite materials, matrix, and reinforcements.
- To equip with knowledge on polymer matrix composites and their production
- To impart knowledge in the manufacturing process and application of various types of metal matrix composites and ceramic composites.
- To become familiar with the recent developments in polymer composite manufacturing.
- To acquire knowledge of selecting suitable composites for industrial applications and the response of composite structures subjected to mechanical loading.

Course Outcomes

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

CO1: Identify the types of composites and the properties of matrix and reinforcements.

CO2: Familiarize the methods used to manufacture polymer matrix composites(PMC) and its applications in different environments.

CO3: Explain the manufacturing methods, concepts and applications of metal matrix composite(MMC) and ceramics composites.

CO4: Explain the recent development in composite manufacturing and its applications.

CO5: Apply the concept of composite materials for various applications with the support of mechanical testing.

1020235332	COMPOSITE MATERIALS	L	T	P	C
PRACTICUM		2	0	2	3

Pre-requisites

Knowledge about the different materials, Basic Chemistry. Material Science

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 Correlation1

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 ensurethat learning is outcome and employability based.

All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

1020235332	**COMPOSITE MATERIALS**	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test 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 Periods	2 Periods	3 Hours	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.

  Answer any 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.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The

practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical documents to be prepared as per the instruction below.

Each exercise the procedure and steps 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 reading and calculations and graph should be written by the student manually in the documents.

The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Description	10
B	Procedure / Tools used / Implementation	20
C	Presentation / Report	30
D	Practical document (All Practicals)	30
E	Viva Voce	10
Total		100

1020235332	COMPOSITE MATERIALS	L	T	P	C
PRACTICUM		2	0	2	3

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.

Syllabus Contents.

UNIT - I	**INTRODUCTION TO COMPOSITES**	
Fundamentals of composites-matrix and reinforcements Matrix- Types of Matrix-Polymer matrix composites(PMC)-Metal Matrix Composites(MMC)-Ceramics Matrix Composites- Concepts and different application Reinforcements-Basic requirements of selection of Reinforcements-Types of Reinforcements-Whiskers-Glass Fiber-Carbon fibers-Aramid fibers-Ceramic fibers-properties and applications.		6
UNIT-II	**MANUFACTURING OF POLYMER MATRIX COMPOSITES**	
Types of PPC manufacturing methods- Hand layup- Spray Layup-Compression Moulding-Sheet forming-Pultrusions-hot press and Autoclave-Filament Winding-Basic principles, construction and application of PPC.		6

1020235332	COMPOSITE MATERIALS	L	T	P	C
PRACTICUM		2	0	2	3

UNIT-III	MANUFACTURING OF METAL MATRIX COMPOSITES (MMC) AND CERAMICS MATRIX COMPOSITES (CMC)	
MMC manufacturing methods- Casting methods- Gravity and low pressure die-squeeze –spray forming-thixo-moulding- basic principles construction and applications CMC manufacturing Methods-Reaction Sintering-Electro Deposition-Spray forming-infiltration- basic principles construction and applications		6
UNIT-IV	**RECENT DEVELOPMENT IN COMPOSITE MANUFACTURING**	
Advanced composites-self healing composites-micro and nano-composites-biodegradable composites-left handed composites-stiffer than stiff composites-carbon and carbon composites- process, applications and limitations.		6
UNIT-V	**SELECTION OF COMPOSITES AND MECHANICAL TESTING**	
Selection of composites for industrial applications- -design and process selectionfor new applications- Daily usage-automobile sectors- aerospace - Product examples and applications. Mechanical testing of Composites-Tensile testing-fatigue testing (three-point bend test)-Toughness mechanism-basic testing procedure, equipment used and test applications.		6
Practical exercise		20
Exercise 1: Material Properties Comparison. **Exercise 2:** Composite Material Selection. **Exercise 3:** Hand Lay-Up Process. **Exercise 4:** Mechanical Testing - Test and analyze the mechanical properties of composite materials. **Exercise 5:** Finite Element Analysis (FEA) **Exercise 6:** Micromechanics Analysis - Explore the microscale interactions within composite materials.		
	ASSESSMENT TEST AND REVISION	10
	TOTAL	60

1020235332	COMPOSITE MATERIALS	L	T	P	C
PRACTICUM		2	0	2	3

Suggested List of Students Activity

1. Visit the composite laboratory.
2. Identify the composite materials used in the Automobile industries.

Reference

1. Suresh, S., Martensen, A., and Needleman, A., "Fundamentals of Metal MatrixComposites", Butterworth, Heinemann, 2013.ISBN: 0080523714, 9780080523712.
2. Strong, A. Brent, "Fundamentals of Composites Manufacturing : Materials, Methods and Applications", First Edition, Society of Manufacturing Engineers, 2008, ISBN 13: 9780872638549.
3. Ru-Min Wang,Shui-Rong Zheng,Ya-Ping Zheng,"Polymer Matrix Composites and Tchnology", First Edition, Woodhead publisher, 2011, ISBN:978-0-85709-221-2.

ONLINE WEB REFERENCES

- https://archive.nptel.ac.in/courses/112/104/112104229/
- https://nptel.ac.in/courses/112104168
- https://archive.nptel.ac.in/courses/101/104/101104010/

List of Equipments Required

Computer - 10 Nos.

Kit and setup required for the Composite Layup.

Software required for the FEA.

1020235332	**COMPOSITE MATERIALS**	L	T	P	C
PRACTICUM		2	0	2	3

END SEMESTER EXAMINATION 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.

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

INTRODUCTION:

Understand the basic concepts of process Planning and estimation and apply different methods of cost estimation in different manufacturing shops and learn the concepts of process planning and cost estimation in competitive manufacturing systems and organizations.

COURSE OBJECTIVES:

The objective of the course is

1. To provide students with a comprehensive understanding of various manufacturing processes, including machining, casting, forming, welding
2. To enable students to select the most appropriate manufacturing processes for a given product and sequence them in an efficient manner.
3. To familiarize students with the selection and use of tools, equipment, and machinery required for manufacturing operations.
4. To enable students to estimate manufacturing costs accurately.
5. To enable students to calculate machining time for various machining operations.

COURSE OUTCOMES:

On successful completion of the course, the students are able to

CO1: Select the process, equipment, and tools for various industrial products.

CO2: Prepare process planning activity chart.

CO3: Explain the concept of cost estimation.

CO4: Compute the job order cost for different types of shop floor.

CO5: Calculate the machining time for various machining operations.

PRE-REQUISITES:

Mathematical skills, Manufacturing processes.

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

CO/PO MAPPING:

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

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

INSTRUCTIONAL STRATEGY:

- Formal face-to-face lectures.
- Present students with the problems related to process planning and cost estimation and guide them through the process of solving those problems.
- Provide opportunities for students to work in a laboratory setting where they can experiment with different process planning tools and techniques.
- Teachers can start a discussion to make sure students take ownership over their own participation and talk through new ideas and skills with peers.
- Teachers guide students as they construct their own knowledge and understanding.
- Active Learning: Activities for active learning can include think-pair-share strategies.

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

ASSESSMENT METHODOLOGY:

	CONTINUOUS ASSESSMENT (40 MARKS)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Written Test 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 Periods	2 Periods	3 Hours	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to Marks	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.

  Answer any 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.

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test.

The students shall be permitted to select any one experiment by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical 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 written in a separate notebook or a printed manual or a file with documents. The reading and calculations and graph should be written by the student manually in the documents.

The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

SCHEME OF EVALUATION - Practical Test

S.NO.	DESCRIPTION	MARKS
A	Aim / Description	10
B	Procedure / Formulae used	20
C	Calculation / Report	20
D	Result	10
E	Practical document (All Practicals)	30
F	Viva Voce	10
Total		**100**

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

- **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.

Syllabus Contents

Unit I	**INTRODUCTION TO PROCESS PLANNING**	
Theory: Aims and objectives, Place of process planning in manufacturing cycle, drawing interpretation, Dimensional tolerance vs Production processes.		6
Practical: 1. Study of various process plans for a product from manufacturing industries.		2
Unit II	**PROCESS PLANNING STEPS**	
Theory: Design of a process plan – selection of production processes, tools, and process parameters- positioning and work holding devices, selection of inspection devices and tools, documenting the process plan, simple case studies. Computer-Aided Process Planning (CAPP) – benefits, architecture, and approaches.		6
Practical: 2. Preparation of process planning sheet for new product design.		2
Unit III	**INTRODUCTION TO COST ESTIMATION**	
Theory: Importance, types, purpose, components, procedure, classification of costs, cost elements, ladder of cost – material cost determination of direct material cost – labour cost,		

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

determination of direct labour cost- over heads – classification of overhead expenses depreciation- methods of depreciation – allocation of overhead expenses, break-even analysis.	6
Practical: 3. Study on elements of cost in a manufacturing sector and their analysis 4. Break-even analysis.	4
Unit IV **PRODUCTION COST ESTIMATION**	
Theory: Estimation of production cost for - casting processes, estimation in welding shop – arc welding – gas welding –flame cutting-estimation of metal forming–forging –forging losses - estimation in foundry shop – moulding – pattern making.	6
Practical: 5. Production cost estimation of welding processes. 6. Production cost estimation of foundry processes shop.	4
Unit V **ESTIMATION OF MACHINING TIME AND COST**	
Theory: Estimation of machining time – lathe operations, drilling, milling, shaping and planning, and grinding, cost estimation for machining processes.	6
Practical: 7. Machining time and cost calculation of shaping process. 8. Machining time and cost calculation of welding process. 9. Machining time and cost calculation of milling process. 10. Machining time and cost calculation of drilling process	8
ASSESSMENT TEST AND REVISION	10
Total hours	**60**

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

SUGGESTED LIST OF STUDENTS ACTIVITY:

- Begin with an overview of what process planning and cost estimation entail. Explain why they are important in various industries.
- Present real-world case studies where process planning, and cost estimation were crucial. Analyze the factors that influenced the success or failure of the projects.
- Discuss the role of risk management in process planning and cost estimation. Explore techniques for identifying, assessing, and mitigating risks that could impact project costs.

TEXTBOOKS & REFERENCE BOOKS:

1. Process and operation planning - Gideon Halevi - Kluwer academic Publishers (Printed-book),2003.
2. Process Planning and Cost Estimation - M.Adithan - New Age International Publishers, 2007.
3. Estimating and Costing for the Metal Manufacturing Industries - Robert Creese, M.Adithan, B.S.Pabla - Marcel Dekker,1992.
4. Manufacturing Processes and Systems, 9th Edition - Phillip F. Ostwald, Jairo Munoz - Wiley student edition, 2008.
5. Production and Costing, 7th edition - G.B.S.Narang, V.Kumar - Khanna Publishers, 2013.

WEB-BASED/ONLINE RESOURCES:

https://www.youtube.com/playlist?list=PLFQ4-HFt2IjT8oFa7xpMioJPofxfU1-ux

https://www.youtube.com/watch?v=dje_JXy-CDo

https://www.youtube.com/watch?v=H6ww3eKJYhU

https://www.youtube.com/playlist?list=PLjfFVTFoi1tW2A9Su3IcB5KweU1IQw63M

1025235333	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
PRACTICUM		2	0	2	3

EQUIPMENTS REQUIRED:

S. NO	NAMEOF THE EQUIPMENT	QTY
1.	Stopwatch	8 Nos.
2.	Welding Setup	2 Nos.
3.	Foundry Shop	2 Nos.
4.	Lathe	6 Nos.
5.	Drilling Machine	2 Nos.
6.	Shaping Machine	2 Nos.
7.	Milling Machine	2 Nos.

END SEMESTER QUESTION PATTERN – THEORY EXAM

Duration: 3 Hours. **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.

1020235334	VALUE ENGINEERING	L	T	P	C
PRACTICUM		2	0	2	3

Introduction

Value engineering is a systematic, organized approach to providing necessary functions in a project at the lowest cost. Value engineering promotes the substitution of materials and methods with less expensive alternatives, without sacrificing functionality. It is focused solely on the functions of various components and materials, rather than their physical attributes.

Course Objectives

The objective of this course is to enable the student

1. To learn the value engineering methodology.
2. To learn how to manage value in projects.
3. To obtain industry-related experience in applying value engineering methods.

Course Outcome

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

CO1: Explain the concepts, techniques and applications of value engineeringCO2: Describe job plan of value engineering.

CO3: Illustrate different value engineering techniques and versatility of value engineering.

CO4: Explain the efforts of value engineering team during the process of value engineering

CO5: Select suitable recent design tools and operating methods.

Prerequisites

Element of Machine Design, Re engineering, CAD/CAM, Quality Management.

1020235334	**VALUE ENGINEERING**	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		
CO2	3		1	1	1		
CO3	3		1	1	1		
CO4	3		1	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 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 Periods	2 Periods	3 Hours	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	

1020235334	VALUE ENGINEERING	L	T	P	C
PRACTICUM		2	0	2	3

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.

  Answer any 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.

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical 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 written in a separate notebook / printed manual / file. The reading and calculations and graph/ should be written by the student manually. The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

1020235334	VALUE ENGINEERING	L	T	P	C
PRACTICUM		2	0	2	3

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Description	10
B	Procedure	20
C	Presentation / Report	20
D	Result	10
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.

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

1020235334	VALUE ENGINEERING	L	T	P	C
PRACTICUM		2	0	2	3

Syllabus Contents

THEORY		
Unit I	**INTRODUCTION OF VALUE ENGINEERING**	
Value engineering (VE), concepts, advantages, applications, problem recognition,and role in productivity, criteria for comparison, element of choice. Organization: Level of value engineering in the organization, size and skill of VE staff, small plant, VE activity, unique and quantitative evaluation of ideas.		6
Unit II	**VALUE ENGINEERING JOB PLAN**	
Introduction, orientation, information phase, speculation phase, analysis phase. Selection and Evaluation of value engineering Projects, Project selection, methods selection, value standards, application of value engineering methodology		6
Unit III	**VALUE ENGINEERING TECHNIQUES**	
Selecting products and operation for value engineering action, value engineering programme, determining and evaluating function(s) assigning rupee equivalents, developing alternate means to required functions, Decision making for optimum alternative, use of decision matrix, queuing theory and Monte Carlo method make or buy, measuring profits, reporting results, Follow up, Use of advanced technique like Function Analysis System.		6
Unit IV	**VERSATILITY OF VALUE ENGINEERING**	
Value engineering operation in maintenance and repair activities, value engineering in non-hardware projects. Initiating a value engineering programme: Introduction, training plan, career development for value engineering specialties.		6
Unit V	**VALUE ENGINEERING LEVEL OF EFFORT**	
Value engineering team, co-coordinator, designer, different services, definitions, construction management contracts, value engineering three case studies.		6

1020235334	VALUE ENGINEERING	L	T	P	C
PRACTICUM		2	0	2	3

Practical Exercises: Value engineering in mechanical engineering aims to optimize the value of products or processes by improving their functionality, quality, and cost-effectiveness. Here are some practical exercises tailored for value engineering mechanical engineering:	20
Exercise 1: Product Analysis and Cost Breakdown: Exercise: Select a mechanical product or component (e.g., gearbox, pump, conveyor system) and conduct a detailed analysis of its design, materials, manufacturing processes, and associated costs. Task students with identifying opportunities for cost reduction while maintaining or improving product performance and reliability. Encourage students to create cost breakdowns and conduct comparative analyses with alternative materials, manufacturing methods, or design modifications.	
Exercise 2: Function Analysis and Functional Decomposition: Exercise: Choose a mechanical system or assembly and perform a functional analysis to identify its primary functions, sub-functions, and interrelationships. Instruct students to decompose the system into its constituent functions and evaluate each function's importance in meeting user requirements. Task students with brainstorming alternative design solutions or modifications that optimize functionality and eliminate unnecessary features or costs.	
Exercise 3: Value Stream Mapping (VSM): Exercise: Provide students with a manufacturing process map or workflow diagram for a mechanical component or assembly. Guide students through the process of creating a value stream map to visualize material and information flow, process cycle times, and areas of waste or inefficiency. Encourage students to identify opportunities for streamlining processes, reducing lead times, and eliminating non-value-added activities to enhance overall value.	
Exercise 4: Design for Manufacturability (DFM) Analysis: Exercise: Assign students a mechanical part or assembly and instruct them to perform a Design for Manufacturability (DFM) analysis.	

1020235334	**VALUE ENGINEERING**	L	T	P	C
PRACTICUM		2	0	2	3

Have students evaluate the design for factors such as ease of manufacturing, assembly, and serviceability, as well as opportunities for standardization and part consolidation. Task students with proposing design modifications or optimizations that simplify manufacturing processes, reduce material waste, and lower production costs.	
Exercise 5: Cost-Benefit Analysis and Trade-off Studies: Exercise: Present students with a design scenario involving conflicting objectives, such as reducing product cost versus improving performance. Guide students through conducting a cost-benefit analysis to quantify the financial impact of different design alternatives. Encourage students to perform trade-off studies to assess the trade-offs between cost, performance, quality, and other key factors, ultimately identifying the most cost-effective solution.	
Exercise 6: Supplier and Material Selection Optimization: Exercise: Provide students with a list of potential suppliers and materials for a mechanical component or system. Instruct students to evaluate supplier capabilities, material properties, lead times, and costs to identify the most suitable options. Task students with negotiating with suppliers, exploring bulk purchasing discounts, and optimizing material selection to minimize procurement costs while ensuring quality and reliability.	
Exercise 7: Life Cycle Cost Analysis (LCCA): Exercise: Assign students a mechanical product or system and instruct them to perform a Lifecycle Cost Analysis (LCCA) considering all costs incurred throughout its lifecycle, including acquisition, operation, maintenance, and disposal. Guide students through quantifying and comparing the total cost of ownership for different design alternatives, highlighting opportunities for long-term cost savings and value optimization.	
Test + Revision	10
Total	60

1020235334	VALUE ENGINEERING	L	T	P	C
PRACTICUM		2	0	2	3

Suggested list of Students Activity

1. Check the web portal to study the material to identify the role and requirement of Value Engineering.
2. Periodical quizzes should be conducted on a weekly/fortnightly basic to reinforce the useof Value Engineering.
3. Students might be asked to visit the mechanical heavy vehicle component manufacturing industry to find the value engineering implementation.

Reference Books

1. Richard Park, "Value Engineering: A Plan for Invention", St. Lucie Press, 1999.
2. Del L. Younker, "Value Engineering analysis and methodology", Marcel Dekker Inc, New York, 2004.
3. Anil Kumar Mukhopadhyaya, "Value Engineering Mastermind: From concept toValue Engineering Certification", SAGE Publications, 2003
4. Anil Kumar Mukhopadhyaya, "Value Engineering: Concepts Techniques and applications", SAGE Publications 2010

END SEMESTER EXAMINATION 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.

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

Introduction

This course explores present manufacturing practices that produce products without much pollution. Green manufacturing refers to the regeneration of production methods and the establishment of ecologically sustainable businesses in the manufacturing industry. In simple terms, it is the "greening" of manufacturing, whereby employees recycle and reuse materials, cut down on waste and pollution, use less natural resources, and decrease emissions during production.

Course Objectives

The objective of this course is to prepare the student.

- To introduce the concept of green manufacturing
- To impart knowledge of pollution and measurement of carbon emissions.
- To become familiar with the recent developments in life cycle management.
- To acquire knowledge of selecting suitable materials, methods, and recycling to make green manufacturing

Course Outcomes

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

CO1: Explain the importance of tools and Techniques used in green manufacturing CO2: Familiarize the causes of industrial air pollutants and methods to measure them in different environments.

CO3: Explain the causes and effects of sound and water pollution.

CO4: Describe the recent developments in life cycle assessment and its implementation.CO5: Apply the concept of green manufacturing designs to suitable for an environment

Pre-requisites

Knowledge of basic chemistry and metrology.

1020235335	GREEN MANUFACTURING	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
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

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.

1020235335	**GREEN MANUFACTURING**	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test 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 Periods	2 Periods	3 Hours	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.

  Answer any 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.

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical documents to be prepared as per the instruction below. Each exercise should be completed on the day of practice. The same shall be evaluatedfor 10 marks on the day or next day of practice before commencement of the next exercise.

  This documentation can be written in a separate notebook or a printed manual or a file with documents. The reading and calculations and graph/ should be written by the student manually in the documents. The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Description	10
B	Procedure	20
C	Presentation / Report	30
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.

Syllabus Contents.

UNIT-I	**INTRODUCTION TO GREEN MANUFACTURING**	
THEORY: Green Manufacturing-Definition-History and evolution of green manufacturing. Factors affecting GM- Environmental Impact of Manufacturing, Strategies for Green Manufacturing. Tools & techniques required -Environmental Conscious, Design for Environment. Design for recycling, Eco friendly Product design methods- Environmental Impact assessment methods and Standards.		6

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

PRACTICAL: **Exercise 1:** Prepare a case study about implementation of green manufacturing. (The students will have to identify smaller problems from industries / research / academic organizations pertaining to green manufacturing, analyze and offer solutions to the problems identified based on the knowledge acquired)		3
UNIT-II	**INDUSTRIAL AIR POLLUTANTS**	
THEORY: Pollutants-Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability- wind velocity and Turbulence-Pump behavior dispersion of air Pollutants. Measurement of air Pollution-Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone.		6
PRACTICAL: **Exercise 2:** Determination of CO and CO2 and unburned hydrocarbons concentration in IC Engine Exhaust.		2
UNIT-III	**NOISE & WATER POLLUTION IN INDUSTRIES8**	
THEORY: Noise pollution in Industries- Frequency and Sound Levels- Effect of human, Environment and properties, Natural and Androgenic Noise Sources-Measuring Instruments for frequency and Noise levels- Masking of sound. Water Pollution-Major pollutants of Water- Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radioactivity in water- Criteria, for different impurities in water- Water Quality requirement for industry Uses-Measurement of water pollution.		6

1020235335	**GREEN MANUFACTURING**	L	T	P	C
PRACTICUM		2	0	2	3

PRACTICAL: **Exercise 3:** To estimate Total Dissolved Solids (DO)and PH value of water supplied to the heat exchanger of any machine. **Exercise 4:** Determination of hardness (temporary, permanent and total) of domestic and industrial waters. **Exercise 5:** Experiment on Industrial noise measurement in any production laboratory. **Exercise 6:** Free and forced vibration measurement on simple cantilever beams / Machine members.	8
UNIT-IV **LIFE CYCLE ASSESSMENT**	
THEORY: Life cycle assessment - Principles of Life cycle assessment; Product Life Cycle Assessment -Triple bottom line approach; Industrial Ecology- Ecological footprinting - Future role of LCA - measurement techniques and reporting. Clean Energy Supply - Green Manufacturing through Clean Energy Supply - Clean Energy Technologies, Application - Potential of Clean Energy. Characteristics of Green manufacturing processes - Energy efficiency analysis of green manufacturing processes - Sustainability analysis and Scope of green manufacturing centers.	6
PRACTICAL: **Exercise 7:** Estimate the Energy requirement of any production machines. **Exercise 8:** Machining under different cooling strategy and estimate the Coolant life management.	4

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

UNIT-V	ENVIRONMENTAL EFFECT OF GREEN MANUFACTURING DESIGN	
THEORY: Green Manufacturing Assessment -Concept Models and Various Approaches, Product Sustainability and Risk/Benefit assessment; Corporate Social Responsibility. Environmental effects of design -Selection of natural friendly material - Eco design - Environmental Damage- Material flow and cycles – Material recycling – Emission less manufacturing- Reduction of toxic emission – design for recycle.		6
PRACTICAL: **Exercise 9:** Estimate the power consumption of spindle and feed drive units power measurement in center lathe / CNC turning or milling machine. (Consider a typical component and record the power using power sensor under different operation conditions and evaluate the energy consumption and efficiency of the process)		3
	Test + Revision	10
	Total	60

Suggested List of Students Activity

The students will have to identify a larger problem from industries/research/academic organizations pertaining to green manufacturing, analyze it, and offer solutions to the problems identified based on the knowledge acquired.

The students have to create a graphical diagram that shows the environmental challengesin the manufacturing shop or laboratory tool room. Suggest the remedial measure.

Students must keep track of the percentage of air pollutants in the classroom. Create a comparison chart for a month.

Reference

- Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
- World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

- Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
- Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
- Canter, R.L., “Environmental Impact Assessment”, McGraw Hill Inc., New Delhi, 1996.
- Shukla, S.K. And Srivastava, P.R., “Concepts In Environmental Impact Analysis”, Common Wealth Publishers, New Delhi, 1992.

Web-based/Online Resources

- https://www.epa.gov/green-engineering/about-green-engineering
- https://ceat.okstate.edu/che/site_files/docs/david-t-allen.pdf
- Green engineering principles and applications, DOI:10.13140/RG.2.2.19639.65449
- https://www.vssut.ac.in/lecture_notes/lecture1424353637.pdf
- https://joycelau99.wordpress.com/wp-content/uploads/2020/10/introduction-to-environmenta l-engineering.pdf
- https://nptel.ac.in/courses/112104225
- https://archive.nptel.ac.in/courses/110/104/110104119
- https://www.youtube.com/watch?v=CsqEClHQBCI&list=PLx3rZEiwFTIO_2_STJGSsq9Mya7kjQVCy
- https://www.youtube.com/watch?v=Ri9rcXxcKdA

1020235335	GREEN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

Instruments/Facilities required to conduct the practical sessions

Sl.No	Equipment/ Instruments required	Quantity Required
1	Sound level Meter(SLM)/ Integrating Sound Level Meter(ISLM)	01
2	CO_2 Meter	01
3	CO Meter	01
4	pH meter	01
5	TDS meter	01
6	Energy meter	01
7	Vibration meter	01
8	Water hardness test kit	01
9	Other metrology instruments(Vernier calliper, thermometer etc)	As reqd

END SEMESTER EXAMINATION 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.

1020235336	LEAN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

Introduction

Lean Manufacturing is a systematic approach to minimizing waste within a manufacturing system while simultaneously maximizing productivity. Originating from the Toyota Production System (TPS), lean manufacturing principles focus on creating more value for customers with fewer resources.

At its core, lean manufacturing aims to streamline production processes, reduce costs, and improve quality by eliminating non-value-added activities. This is achieved through various techniques and tools that emphasize continuous improvement, such as 5S (Sort, Set in order, Shine, Standardize, Sustain), Kaizen (continuous improvement), Value Stream Mapping, and Just-In-Time (JIT) production.

For diploma engineering students, learning about lean manufacturing provides essential skills and knowledge to optimize production processes, enhance operational efficiency, and contribute to the overall competitiveness of a manufacturing enterprise. By understanding and applying lean principles, students can play a pivotal role in transforming traditional manufacturing setups into more agile, responsive, and waste-free operations.

Course Objectives

It is desired that at the end of the course, the student will be equipped with the basic knowledge of lean manufacturing, tools, techniques and implementation outcomes.

Course Outcomes

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

CO1: Explain the importance of tools used in lean manufacturing.

CO2: Explain the importance of tools and technique of TQM.

CO3: Understand the objective and functions of TPM.

CO4: Describe the Design of Experiments, Designing for Quality, and Quality in Service Sectors.

CO5: Apply the concept of six sigma and quality circle.

1020235336	LEAN MANUFACTURING	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
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

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their curiosityto 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.

1020235336	**LEAN MANUFACTURING**	L	T	P	C
PRACTICUM		2	0	2	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	CA2	CA3	CA4	
Mode	Written Test 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 Periods	2 Periods	3 Hours	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.

  Answer any 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.
- **CA 3:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one experiment by lot for the test. The

practical test should be conducted as per the scheme of evaluation as below. The marks awarded for 100 marks 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 practical 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 Procedure, steps, observations and report should be written by the student manually in the documents. The evaluated practical document should be submitted for the Practical Test (CA3). The mark scored by the students should be converted to 30 marks. The same should be included as per the allocation in the practical test.

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

SCHEME OF EVALUATION - Practical Test

Sl.No.	Description	Marks
A	Aim / Description	10
B	Procedure / Steps	20
C	Presentation / Report	30
E	Practical document (All Practicals)	30
F	Viva Voce	10
Total		100

1020235336	**LEAN MANUFACTURING**	L	T	P	C
PRACTICUM		2	0	2	3

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.

Syllabus Contents.

UNIT I	**Introduction**	
Lean Manufacturing: Introduction, Definitions of Lean manufacturing, explaining basic concepts. Overview of historical development. Management theory. Primary Tools of Lean manufacturing: 5-S, Workplace organization, Total Productive Maintenance, Process mapping - Value stream mapping, Work cell. Secondary Tools of Lean manufacturing: Objective and benefits of Secondary lean tool, Cause and Effect diagram, Pareto chart, Spider chart, Poka yoke, Kanban, Automation, Single minute exchange of die (SMED), Design for manufacturing and assembly, Just in time (JIT), Visual workplace, OEE.		6
UNIT II	**Total Quality Management**	
TQM Tools And Techniques: The seven traditional tools of quality, New management tools, and Six sigma: Concepts, methodology, applications to manufacturing, service sector including IT, Benchmarking, Reason to bench mark, Benchmarking process, FMEA, Stages, and Types. Quality circles , Quality Function Deployment (QFD), Taguchi quality loss function, TPM ,Concepts, improvement needs, Cost of Quality , Performance measures.		6

1020235336	LEAN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

UNIT III	Total Productive Management	
Total Productive Maintenance: Objectives and functions, Tero technology, Reliability Centered Maintenance (RCM), maintainability prediction, availability and system effectiveness, maintenance costs, maintenance organization. Minimal repair, maintenance types, balancing PM and breakdown maintenance, Primary and secondary tool for TPM, Case studies related to TPM.		6
UNIT IV	**Design of Experiments, Designing for Quality, Quality in Service Sectors.**	
Design of Experiments: Introduction , Methods, Taguchi approach, Achieving robust design, Steps in experimental design Designing for Quality: Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA), Concept, Methodology and Application (with case studies). Quality in Service Sectors: Characteristics of Service Sectors, Quality Dimensions in Service Sectors, Measuring Quality in Different Service Sectors.		6
UNIT V	**Six Sigma, Quality Circle.**	
Six Sigma: Meaning of six sigma, Why six sigma, Six sigma improvement model, DMAIC and DMADV principle, , building six sigma organization and culture, Six sigma application. Quality Circle: Quality Circle structure, Its operation, Characteristics of Quality Circle, developing quality circle in organization, Basic problem solving techniques.		6
PRACTICAL EXERCISES		20
Exercise 1: Conduct a 5S audit in a specific area of the plant. Create a checklist for each of the 5S steps and evaluate and implement improvements. **Exercise 2**: Create a preventive maintenance plan for a critical piece of equipment. Document the steps, schedule the maintenance tasks, and assign responsibilitiesto maintenance personnel.		

1020235336	LEAN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

Exercise 3: Identify a recurring equipment issue and organize a Kaizen event to address it. Use root cause analysis to identify the underlying problem and implement a solution using the PDCA cycle. **Exercise 4**: Create an SOP for a routine maintenance task. **Exercise 5**: Root Cause Analysis with 5 Whys. Identify a specific issue and ask "Why?" it occurred. Continue asking "Why?" for each answer until the root cause is identified (typically five times). Document the process and solutions to address the root cause. **Exercise 6**: Pareto Chart Creation. Use the data collected on defects to create a Pareto chart. List the types of defects in descending order of frequency and plot the cumulative percentage. Identify the top 20% of defects that cause 80% of the problems and prioritize them for improvement.	
ASSESSMENT TEST AND REVISION	10
Total	60

Reference

1. J Evans and W Linsay, The Management and Control of Quality, 6'th Edition, Thomson, 2005.
2. Besterfield, D H et al., “Total Quality Management”, 3rd Edition, Pearson Education, 2008.
3. D. C. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, 6th Edition, 2004.
4. K C Jain and A K Chitale , “Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000)” by, Khanna Publishers.
5. B. L. Hanson & P. M. Ghare, “Quality Control & Application”, Prentice Hall of India.

1020235336	LEAN MANUFACTURING	L	T	P	C
PRACTICUM		2	0	2	3

END SEMESTER EXAMINATION 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.