GOVERNMENT OF TAMIL NADU

DEPARTMENT OF TECHNICAL EDUCATION

DIPLOMA IN ENGINEERING & TECHNOLOGY REGULATION 2023

1221 DIPLOMA IN MECHANICAL ENGINEERING(R&A/C) /1024 REFRIGERATION & AIR CONDITIONING

Diploma in Mechanical Engineering (Refrigeration and Air Conditioning)

Program Outcomes (PO's)

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

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

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

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

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

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

PO4: Engineering Tools, Experimentation, and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements. PO5: Engineering practices for society, sustainability and environment: Apply appropriate technology in the context of society, sustainability, environment and ethical practices.

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

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

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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	620	22
Semester VI	3	660	18
Total	43	3840	120

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1221 DIPLOMA IN MECHANICAL ENGINEERING(R&A/C) /1024 REFRIGERATION & AIR CONDITIONING

Semester III

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1221233110	Basic Manufacturing Technology	3-0-0	45	3	Theory
2	Program Core	Practicum	1221233230	Engineering Thermodynamics	3-0-2	75	4	Theory
3	Program Core	Practicum	1221233340	Mechanics of Materials	1-0-4	75	3	Practical
4	Program Core	Practicum	1020233440	Industrial drives and control *	1-0-4	75	3	Practical
5	Program Core	Practicum	1221233540	R&A/C workshop	1-0-4	75	3	Practical
6	Program Core	Practical/Lab	1221233620	Basic Manufacturing Technology Practical	0-0-4	60	2	Practical
7	Open Elective	Advanced Skill Certification	1020233760	Advanced Skills Certification – III*	1-0-2	60	2	NA
8	Humanities & Social Science	Integrated Learning Experience	1020233880	Growth Lab*	-	30	0	-
9	Audit Course	Integrated Learning Experience	1020233881	Induction Program – II*	-	16	0	-
10	Audit Course	Integrated Learning Experience	1020233882	I&E/ Club Activity/ Community Initiatives*	-	16	0	-
11	Audit Course	Integrated Learning Experience	1020233883	Shop floor Immersion*	-	8	0	-
12	Audit Course	Integrated Learning Experience	1020233884	Student-Led Initiative*	-	22	0	-
13	Audit Course	Integrated Learning Experience	1020233885	Emerging Technology Seminars*	-	8	0	-
14	Audit Course	Integrated Learning Experience	1020233886	Health & Wellness*	0-0-2	30	1	-
***Common with mechanical**								
				Test & Revisions		30		NA
				Library		15		
				Total		**640**	**21**	

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1221 DIPLOMA IN MECHANICAL ENGINEERING(R&A/C) /1024 REFRIGERATION & AIR CONDITIONING

Semester IV

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Theory	1221234110	Refrigeration	3-0-0	45	3	Theory
2	Program Core	Practicum	1221234230	Fluid Mechanics and Machines	2-0-2	60	3	Theory
3	Program Core	Practicum	1221234340	HVAC CAD Drawing	1-0-4	75	3	Practical
4	Program Core	Practicum	1020234440	Sensors and actuators *	1-0-4	75	3	Practical
5	Program Core	Practical/Lab	1221234520	Refrigeration practical	0-0-4	60	2	Practical
6	Program Core	Practicum	1020234640	Metrology and Measurements*	1-0-4	75	3	Practical
7	Open Elective	Advanced Skill Certification	1020234760	Advanced Skills Certification – IV*	1-0-2	60	2	NA
8	Audit Course	Integrated Learning Experience	1020234882	I&E/ Club Activity/ Community Initiatives*	-	30	0	-
9	Audit Course	Integrated Learning Experience	1020234883	Shop floor Immersion*	-	8	0	-
10	Audit Course	Integrated Learning Experience	1020234884	Student-Led Initiative*	-	24	0	-
11	Audit Course	Integrated Learning Experience	1020234885	Emerging Technology Seminars*	-	8	0	-
12	Audit Course	Integrated Learning Experience	1020234886	Health & Wellness*	-	30	0	-
13	Audit Course	Integrated Learning Experience	1020234887	Special Interest Groups (Placement Training)*	-	30	0	-
Common with mechanical								
				Test & Revisions		30		
				Library		30		
				Total		**640**	**19**	

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DIPLOMA IN ENGINEERING & TECHNOLOGY REGULATION 2023

1221 DIPLOMA IN MECHANICAL ENGINEERING(R&A/C) /1024 REFRIGERATION & AIR CONDITIONING

Semester V

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Core	Practicum	1221235130	Air conditioning	3-0-2	75	4	Theory
2	Program Core	Practicum	1020235230	Industrial Engineering and Management*	3-0-2	75	4	Theory
3	Program Elective	Theory		Elective-1	3-0-0	45	3	Theory
4	Program Core	Practical/Lab	1221235420	HVAC Machines Practical	0-0-4	60	2	Practical
5	Program Elective	Practicum		Elective-2	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	1020235773	Industrial Training* [Summer Vacation - 90 Hours]	0-0-4	-	2	Project
8	Open Elective	Advanced Skill Certification	1020235860	Advanced Skills Certification – V*	1-0-2	60	2	NA
9	Audit Course	Integrated Learning Experience	1020235981	Induction program – III*	-	40	0	-
10	Audit Course	Integrated Learning Experience	1020235984	Student-Led Initiative*	-	30	0	-
11	Audit Course	Integrated Learning Experience	1020235986	Health & Wellness*	-	30	0	-
12	Audit Course	Integrated Learning Experience	1020235987	Special Interest Groups (Placement Training)*	-	40	0	-
***Common with mechanical**								
				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	1020236351	Internship*	-	540	12	Project
3	Industrial Training / Project	Project/Internship	1020236353	Fellowship*	-	540	12	Project
3	Industrial Training / Project	Project/Internship	1020236374	In-house Project*	-	540	12	Project

Note: * Common with mechanical

** 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	Theory	1221235311	Heating system	3-0-0	45	3	Theory
2	Program Elective	Theory	1221235312	HVAC Machines	3-0-0	45	3	Theory
3	Program Elective	Theory	1221235313	Cryogenic Engineering	3-0-0	45	3	Theory
4	Program Elective	Theory	1221235314	Food processing and preservation	3-0-0	45	3	Theory
5	Program Elective	Theory	1221235315	Transport and special application of HVAC	3-0-0	45	3	Theory

Elective - II

#	Course Category	Course Type	Code	Course Title	L-T-P	Period	Credit	End Exam
1	Program Elective	Practicum	1221235541	HVAC Machine service practice	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	IndustrialIoT*	1-0-4	75	3	Practical
4	Program Elective	Practicum	1221235544	Computer Integrated Manufacturing	1-0-4	75	3	Practical
5	Program Elective	Practicum	1020235545	Industrial Robotics*	1-0-4	75	3	Practical

***Common with mechanical**

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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	1221236113	Applications of HVAC System	3-0-0	45	3	Theory
4	Elective | Technocrats	Theory	6000236114	Finance Fundamentals*	3-0-0	45	3	Theory
5	Elective | Technologists	Theory	1020236115	Industry4.0*	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

***Common with mechanical**

$ 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	1221236244	Automobile Engineering	1-0-4	75	3	Practical
5	Elective	Practicum	1020236245	Product Design & Development*	1-0-4	75	3	Practical
6	Elective	Practicum	1221236246	Heat Transfer in HVAC system	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

***Common with mechanical**

1221233110	BASIC MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Introduction

Manufacturing is the major and the most important aspect in industries, needs utmost care and attention. Knowledge about various processes and allied areas will be of great use to the personnel involved in production. This will provide the students an opportunity to skill themselves for the industrial scenario.

Course Objectives

The objective of this course is to enable the student,

- Acquire Knowledge about types of patterns, casting, and moulding.
- Knowledge about various welding process
- Knowledge about the lathe and its working parts
- Acquire basic knowledge on powder metallurgy and different types of grinding machines.
- Acquire basic knowledge on drilling machines and various drilling operations

Course Outcomes

After successful completion of this course, the students should be able to CO1:

Understand the basics of casting process.

CO2: Acquire knowledge in welding and welding related processes.

CO3: Understand components of lathe and operations performed in lathe.

CO4: Significance of powder metallurgy, process of making metal powders, design considerations in making powder metallurgy components.

CO5: Acquire knowledge in drilling and grinding process and machines.

Pre-requisites

Nil

1221233110	BASIC MANUFACTURING 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	1	1	1	2	2
CO2	3	2	2	1	1	1	2
CO3	3	2	2	2	3	1	2
CO4	3	2	3	2	1	2	1
CO5	3	2	1	2	2	2	2

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

Instructional Strategy

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

1221233110	BASIC 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.

1221233110	BASIC MANUFACTURING 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 each.

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

1221233110	BASIC MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Syllabus Contents

Unit I	**BASICS OF CASTINGPROCESSES**	
Patterns - Definition – pattern materials – factors for selecting pattern materials – overview of types ofPatterns– solidpiece,splitpatterns,loosepiece,matchplate,sweep,skeleton,segmental,shell– types of patternallowances Moulding -Definition — moulding boxes, moulding sand — ingredients – propertiesofmouldingsand–sandadditives–mouldingsandpreparation Casting -Definition— sandcastingusinggreensandanddrysand– pressure die casting – hot and cold chamberprocesses-melting of cast iron – cupola furnace – meltingofnonferrousmetals–cruciblefurnacemeltingofsteel-arcfurnaces direct and in direct –defectsincasting–causesandremedies.		12
Unit II	**BASICS OF WELDING**	
Introduction permanent – semi-permanent and temporary joining process overview– typesofweldedjoints ArcWelding - Definition – arc welding equipment – arc welding methods – carbonarc, metal arc, Metal Inert gas (MIG), Tungsten inert gas (TIG) Gaswelding - Definition Gas Welding Equipment– Oxy and acetylene welding - Threetypes of flame Resistance welding - classification of resistancewelding–butt—spot—seam weldingrelatedprocesses– oxy and acetylene cutting – arc cutting– soldering and brazing		8
Unit III	**BASICS OF LATHE**	
Centre Lathe Theory of lathes – specifications – simple sketches – principal parts -operations in lathe- plain –step-taper turning – types of taper turning methods-thread cutting-drilling		8

1221233110	BASIC MANUFACTURING TECHNOLOGY	L	T	P	C
THEORY		3	0	0	3

Unit IV	BASICS OF POWDER METALLUGY	
PowderMetallurgy –Introduction – significances-applications-overview-Methodsofmanufacturingmetalpowders–atomization,reductionandelectrolysisdeposition– compacting–sintering–sizing–infiltration–mechanical properties of parts made by powder metallurgy – designrulesforthepowermetallurgyprocess.		8
UNIT V	**BASICS OF DRILLING AND GRINDING**	
Drilling Drilling - principle of operation in drilling- types ofdrilling machines - bench type - floor type - radial type - gang drill -multi spindle type - drillingoperation- reaming, counter sinking, counter boring, spot facing, tapping anddeepholedrilling. Grinding: introduction-principle of operation- grinding machine Types and classification - specifications - rough grinding — pedestalgrinders-portablegrinders-beltgrinders.Precisiongrinding-cylindrical grinder - centerless grinders - surface grinder - tool andcuttergrinder		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 list of different pattern material.
2. Prepare a list containing the specifications of a typical centre lathe.
3. Prepare a list of arc welding methods.
4. Prepare a table containing methods of manufacturing metal powders.

1221233110	BASIC MANUFACTURING 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., Seewai Building `B‘, 20-G, Noshir Bharucha Marg, Mumbai 400 007 – 2007.
2. Workshop Technology – Raghuwanshi - Khanna Publishers. Jain & Gupta, Production Technology, Edn. XII, Khanna Publishers, 2-B, North Market, NAI Sarak,New Delhi 110 006 - 2006
3. Production Technology - P. C. SHARMA - Edn. X - S.Chand & Co. Ltd., Ram Nagar,New Delhi 110 055 – 2006
4. Production Technology – HMT - Edn. 18 - published by Tata McGraw HilL publishing Co. Ltd., 7 West Patel nagar, New Delhi 110 008. – 2001.

Web Reference

1. https://www.youtube.com/watch?v=0iezQ4IeXsc – Metal Casting
2. https://youtu.be/8RUXvdsgsyg - Sand Properties
3. https://www.youtube.com/watch?v=dMcP3aCHyTQ&t=6s –Welding Tech
4. https://www.youtube.com/watch?v=EJ94XC0YfZc&t=801s- Metal Forming
5. https://www.youtube.com/watch?v=AZMbSBVVWhI- Powder metallurgy
6. https://www.youtube.com/watch?v=748_ME0p0Ag- Heat Treatment process

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.

1221233230	**ENGINEERING THERMODYNAMICS**	L	T	P	C
PRACTICUM		3	0	2	4

Introduction:

The knowledge of thermodynamics is very much important for understanding the basic refrigeration cycle which includes various thermodynamics processes and system. The study of steady flow systems and energy equations are also vital to deal for refrigeration studies. For engineers working in the field of refrigeration & air conditioning, the way the heat flow is very important in many instances like sizing HVAC equipment in the estimated heat load of a building. Further mechanical engineer, have to work with various power producing and consuming devices like IC engines, air compressor etc., knowledge of thermodynamics is mandatory. Hence it is important to study the course of thermodynamics in order to understand the concept of energy, work heat and conversion between them.

Course Objectives:

The objective of this course is to enable the student to

- Outline the definitions of zeroth, first and second law of thermodynamics.
- Explain the basics of different thermodynamic processes.
- Acquire the knowledge of steady flow system, steady flow energy equation and its applications.
- Understand the components and working of IC engines.
- Understand the types of air compressor and its working.

Course Outcomes:

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

CO1: Demonstrate zeroth, first and second law of thermodynamics.
CO2: Understand the different thermodynamic processes.
CO3: Acquire knowledge in steady flow system, steady flow energy equation and its applications.
CO4: Identify IC engine components and understand the working of IC engine. CO5: Describe the types of air compressor and its working.

Pre-requisites:

Knowledge of basic mathematics and Science

CO/PO Mapping

1221233230	**ENGINEERING THERMODYNAMICS**	L	T	P	C
PRACTICUM		3	0	2	4

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations, and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome- and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any.

1221233230	**ENGINEERING THERMODYNAMICS**	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

1221233230	ENGINEERING THERMODYNAMICS	L	T	P	C
PRACTICUM		3	0	2	4

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 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 log book 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

1221233230	ENGINEERING THERMODYNAMICS	L	T	P	C
PRACTICUM		3	0	2	4

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.

Syllabus Contents

Unit I	**FUNDAMENTALS OF THERMODYNAMICS**	
Theory: Introduction–definitionsandunitsofmass,weight,volume,density - specificweight,specificgravityandspecificvolume–pressure–unitsofpressure–temperature-absolutetemperature–S.T.PandN.T.Pconditions – heat -specific heat capacity at constant volume and at constantpressure–work-power-energy-types-lawofconservationofenergy–thermodynamicsystem–types–thermodynamicequilibrium-propertiesofsystems – intensive and extensive properties –State of System-process–cycle–pointandpathfunctions-zeroth,firstand secondlawsofthermodynamics- Perfectgases–lawsofperfectgases–Boyle's,Charles',Joule's, Regnault's and Avogadro's laws –General Gas Equation-characteristic gas equation – relation between specific heats andgasconstant–universalgasconstant – Simple problems		9
Practical: **Ex#:01** Study of various thermodynamic systems **Ex#:02** Determination of gas constant for gases such as Nitrogen, Oxygen and Hydrogen from universal gas constant and its molecular weight		6
Unit II	**THERMODYNAMIC PROCESSES**	
Theory:		8

1221233230	**ENGINEERING THERMODYNAMICS**	L	T	P	C
PRACTICUM		3	0	2	4

ThermodynamicProcesses- Definition - ChangeinInternalEnergy-enthalpy–changeinenthalpy–entropy–changeinentropy–generalequationsforchangeinentropy- simple problems ConstantVolume,ConstantPressure,Isothermal,Isentropic(reversibleadiabatic),Polytropic–P-VandT-Sdiagrams- work done, change in internal energy, heat transfer,changeinenthalpy,changeinentropyforabove processes– simple problems in all processes except polytropic process-Freeexpansionandthrottlingprocesses (Description only)	
Practical: **Ex#:03** Study of various thermodynamic processes **Ex#:04** Study of P-VandT-Sdiagrams for constant volume, constant pressure, IsentropicandPolytropic processes	6
Unit III **STEADY FLOW SYSTEMS AND STEADY FLOW ENERGY EQUATION**	
Theory: Steady flow system-control volume-assumptions in steady flow systems-Steady flow energy equation-applications- SFEE for Boilers, steam condenser, Rotary and Reciprocating Compressor, steam and gas turbines, and Nozzles-simple problems	5
Practical: **Ex#:05** Study of applications of steady flow energy equations	3
Unit IV **IC ENGINES**	
Theory: Internalcombustionengines.ClassificationsofI.CEngines–components of I.C Engines – cylinder- cylinder block-cylinder head- cylinder liners-crank case-piston-piston rings-connecting rod- - Working of four stroke diesel engines and twostroke petrol engines - comparison of four strokeandtwostrokeengines–Comparisonof petrolanddieselengines--valve timing diagram for four stroke diesel engines – porttimingdiagramfortwostrokepetrolengines.Layoutoffuel supply systeminpetrol engines	6
Practical: **Ex#:06** Study and identification of IC engine components	9

1221233230	**ENGINEERING THERMODYNAMICS**	L	T	P	C
PRACTICUM		3	0	2	4

Ex#:07 Draw port timing diagram of two stroke petrol engine **Ex#:08** Draw valve timing diagram of four stroke diesel engine	
Unit V	**AIR COMPRESSORS**
Theory: Compressor- uses of compressed air-classification of air compressor-reciprocating compressor-single stage reciprocating compressor-compression processes- clearance volume -volumetric efficiency-multistage compression- merits and demerits-two stage compressor – rotary compressor-roots blower-centrifugal compressor- vane blower-axial flow air compressor- construction and working- no problems	7
Practical: **Ex#:09** Study of reciprocating and centrifugal compressor **Ex#:10** Study of multistage compression, its merits and demerits	6
Revision + Test + Students Activity	10
TOTAL HOURS	75

Suggested List of Students Activity:

1. Presentation/Seminars by students on any recent technological developments based on fundamental thermodynamics
2. Periodic class quizzes conducted on a weekly/fortnightly basis to reinforce the basic thermodynamic concepts

Text and Reference books:

1. R. K. Rajput, Thermal Engineering, 11th Edition, Laxmi publications Pvt Ltd , New Delhi, 2020.
2. R.S. Khurmi, J. K. Gupta, A Textbook of Thermal Engineering, S. Chand Publishing, 2019.
3. R. K. Rajput , A Text Book of Automobile Engineering, Laxmi publications Pvt Ltd, New Delhi, 2012.
4. P. K. Nag, Basic And Applied Thermodynamics 2/E, McGraw-Hill Education (India) Pvt Limited, 2010.

1221233230	**ENGINEERING THERMODYNAMICS**	L	T	P	C
PRACTICUM		3	0	2	4

Web reference:

- NPTEL (Website):https://archive.nptel.ac.in/courses/112/103/112103316/
- NPTEL (Website):https://archive.nptel.ac.in/courses/112/103/112103262/

Equipment / Facilities required to conduct the Practical Portions.

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl.No	Equipments	Nos
01	IC Engine Components	1 set
02	2 Stroke Petrol Engine Cut Section model for to draw port timing diagram	1
03	4 Stroke Diesel Engine Cut Section model for to draw port timing diagram	1

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.

1221233230	**ENGINEERING THERMODYNAMICS**	L	T	P	C
PRACTICUM		3	0	2	4

1221233340	**MECHANICS OF MATERIALS**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Day by day Engineering and Technology experiences tremendous growth. Design plays a major role in developing engineering and technology. Mechanics of material is backbone for design. Mechanics of material deals generally with the behaviour of material, when they are subjected to actions of forces. Evaluations derived from these, provide the tools for investigation of mechanical structure.

Course Objectives:

The objective of this course is to enable the student to

- Understand the deformation of materials, when are subjected to load and conduct material testing on hardness and shear test and acquire skills on different types of testing method of metals.
- Familiarize the stress strain diagram and able to handle UTM
- Determine modulus of rigidity of open coil spring and closed coil spring.
- Determine the Rigidity modulus of the material of circular shafts using torsion testing machine
- Estimate the stresses induced in thin cylindrical and spherical shells.

Course Outcomes:

After successful completion of this course, the students can able to CO 1: Understand the material testing procedure for hardness, shear etc.
CO 2: Describe stress strain diagram and handle UTM.
CO 3: Find out modulus of rigidity of open coil spring and closed coil spring by using spring testing machine.
CO 4: Handle torsion testing machine and find out modulus of rigidity of shaft materials. CO 5: Determine stresses induced in thin cylindrical and spherical shells.

Pre-requisites:

Knowledge of Basic Mathematics and Science.

CO/PO Mapping

1221233340	MECHANICS OF MATERIALS	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

1221233340	MECHANICS OF MATERIALS	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester
	CA1	**CA2**	**CA3**	**CA4**	**Examination (60 marks)**
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	50% Exercises	50% 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.

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

1221233340	MECHANICS OF MATERIALS	L	T	P	C
PRACTICUM		1	0	4	3

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 a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim and procedure	10
B	Observation and tabulation	15
C	Calculations	20
D	Results	05
E	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.

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

1221233340	**MECHANICS OF MATERIALS**	L	T	P	C
PRACTICUM		1	0	4	3

TOTAL	100 Marks

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

Part	Description	Marks
A	Aim and procedure	10
B	Observation and tabulation	20
C	Calculations	25
D	Results	05
E	Written Test (Theory Portion)	30
F	Viva Voce	10
TOTAL MARKS		**100**

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

Syllabus Contents

Theory Portion	
Unit I	**MECHANICAL PROPERTIES OF MATERIALS**

1221233340	**MECHANICS OF MATERIALS**	L	T	P	C
PRACTICUM		1	0	4	3

Importance of mechanical properties of materials. Definition and brief explanation of mechanical properties-elasticity, plasticity, stiffness, ductility, malleability, brittleness, toughness, hardness, wear resistance, machineability, weldability, castability.		3
Unit II	**SIMPLE STRESS AND STRAIN**	
Behavior of materials when subjected to load-Definition - load, stress and strain- classification of force systems - tensile, compressive, shear, bending and torsional force systems -behavior of metals in tension up to rupture-stress strain diagram-limit of proportionality-Hooks law -elastic limit-yield point-breaking point-ultimate stress percentage elongation and percentage reduction in area. Modulus of elasticity, Bulk modulus and Rigidity modulus – definition only-relation between E, N and K		3
Unit III	**SPRINGS**	
Springs Types of springs – Laminated and coiled springs and applications – Types of coiled springs – Difference between open and closely coiled helical springs – closely coiled helical spring subjected to an axial load – no derivation-Formula for finding shear stress, deflection, stiffness and resilience of closed coiled helical springs.		3
Unit IV	**THEORY OF TORSION**	
Introduction –assumptions in theory of pure torsion – torsion equation (no derivation)Strength of solid and hollow shafts – power transmitted – Definition – Polar modulus-polar moment of inertia for solid and hollow shaft – Torsional rigidity – strength and stiffness of shafts – comparison of hollow and solid shafts – Advantages of hollow shafts over solid shafts – No Problems.		3
Unit V	**THIN CYLINDERS AND SPHERICAL SHELLS**	
Introduction-. Definition of Thin and thick cylindrical shell – stresses in cylindrical shellshoop stress and longitudinal stress. Formula for hoop and longitudinal stress Thin spherical shells definition formula for stress in spherical shells		3

Practical Exercise

Ex. No	Name of the Exercise	Hours
1	Determination of Rockwell's Hardness Number for the materials mild steel, copper and aluminium	4

1221233340	MECHANICS OF MATERIALS	L	T	P	C
PRACTICUM		1	0	4	3

2	Impact test – finding the resistance of materials to impact loads by Izod test or Charpy test	4
3	Study of stress-strain diagram for MS rod when subjected to tenson.	4
4	Tension test on a specimen in UTM.	4
5	Shear test [single or double] on mild steel bar to find the resistance of material to shear load.	4
6	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method for open coil helical spring.	4
7	Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method for closed coil helical spring.	4
8	Torsion test on mild steel-relation between torque and angle of Twist determination of shear modulus and shear stress	4
9	Comparative case Study on solid and hollow shafts.	4
10	Study of stresses involved in thin cylinder and spherical shells	4
	Practice + Continuous Test + Revision	20
	TOTAL HOURS	**75**

Suggested List of Students Activity:

1.Students shall prepare hardness number table for different metals 2.Prepare young's modulus valves tables for different materials

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-based Online Resources:

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

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	TOOLS AND EQUIPMENTS	Nos
01	Rockwell ‘s Hardness testing machine	1No
02	Izod or Charpy impact testing machine	1No
03	UTM	1No
04	Shear testing machine	1No
05	Torsion testing machine	1No
06	Spring testing machine	1No

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

Practical document should be submitted for the examination with a bonafide certificate.

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim and procedure	10
B	Observation and tabulation	20
C	Calculations	25

1221233340	**MECHANICS OF MATERIALS**	L	T	P	C
PRACTICUM		1	0	4	3

D	Results	05
E	Written Test (Theory Portion)	30
F	Viva Voce	10
	TOTAL MARKS	**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

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 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.

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

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

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 log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	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.

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

Question pattern – Written Test Theory

Description		Marks	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 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 – Fundamentals of 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 phase ac 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 of Half 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

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

	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 over load and/or Short Circuit fault. b) Connect ELCB with Lamp Load and Test the Tripping Operation for Earth fault.	4

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

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.	4
	b)Compare and Discuss the observations.	

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 – Types of Electrical Braking – Selection of Motors for different applications – Motors used for 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**

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

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

8.	SPEED CONTROL OF INDUCTION MOTOR USING VFD Activity to Perform: a) Make connections and Control the speed of the given single phase 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

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

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/

Equipment / Facilities required to conduct the Practical Course.

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

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:

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

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

1020233440	**INDUSTRIAL DRIVES AND CONTROL**	L	T	P	C
PRACTICUM		1	0	4	3
	TOTAL	100			

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

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

R&A/C Workshop Practices help to develop the technical hands-on skills required by the technicians working in various Engineering HVAC sectors. This course intends to impart the basics of hand tools and their uses in different sections of HVAC servicing. The topics covered are based on the syllabus for diploma studies in R&A/C Engineering. The course is planned to include basic practical experience in copper tube operations such as flaring, swaging and brazing. The ducts, its types are to be studied and a model duct to be fabricated are included. The instruments used in the service area of HVAC are included to improve the skills of the students. Basic electricals applied in R&A/C systems is included to improve the service skills of the students.

Course Objectives:

The objective of this course is to enable the student to

- Identify the various tools used in R&A/C sectors
- Do various copper tube operations.
- Fabricate model ducts.
- Handle sling psychrometer and take readings.
- Test the condition of starting, running capacitor and thermostat switch.

Course Outcomes:

After successful completion of this course, the students can able to CO 1: Identify, handle the various tools used in R&A/C sectors.
CO 2: Familiar in doing various copper tube operations.
CO 3: Fabricate prototype ducts.
CO 4: Understand the use of sling psychrometer and take readings.
CO 5: Understand the testing procedure for the condition of starting, running capacitor and thermostat switch. **Pre-requisites:**

Nil.

CO/PO Mapping

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

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

1221233540	**R&A/C WORKSHOP**	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 printed manual or a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim	05
B	Procedure	10
C	Testing/execution of experiment/copper tube operation/duct fabrication	30
D	Result	05
E	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.

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ from the complete theory portions.	30 X 1 Mark	30 Marks

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

Part – B	Seven Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

Part	**Description**	**Marks**
A	Aim	05
B	Procedure	10
C	Testing/execution of experiment/copper tube operation/duct fabrication	40
D	Result	05
E	Written Test (Theory Portion)	30
F	Viva voce	10
	TOTAL MARKS	**100**

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

Syllabus Contents

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion		
Unit I	**REFRIGERATION AND AIR CONDITIONING TOOLS**	
Introduction – Major Tool`s used in R&A/c field – Tube cutter – Flaring tools – Yoke – Swaging tools –Mechanical pipe bender – Outer spring bender – Inner spring bender – Pinching tools – Manual type – Spring type – Reaming tool– Piercing tools – Quick charging adapter – Gas tin Cylinder – valve – valve key – Ratchet wrench – Flexible charging hose – Charging valves – Storage cylinder – Vacuum pump – Identification of usage.		3
Unit II	**COPPER TUBE OPERATIONS**	
Introduction – Copper tube sizes – Copper tube joints – Coupler, Regular joint, Elbow, T Joint, Flare joint – Copper tube operations – Cutting and Flaring, Swaging and Brazing, Bending, Straightening and Pinching.		3
Unit III	**DUCT AND ITS TYPES**	
Introduction – Classification of ducts – Supply air duct, Return air duct, Fresh air duct, Low pressure, medium pressure Duct, High pressure duct, Low velocity duct, High velocity duct – Duct materials – Galvanized sheet metal, Aluminium – Nonmetal duct – Resin bonded glass fibre duct, Cement asbestos duct, Wooden duct, Pvc duct – Duct joints – Grooved seam joint, Drive slip joint, Flat joint, Double seam corner joint, Standing seam riveted joints, Slip joint – Duct shape – Circular, Rectangular, Square, Collapsible duct.		3
Unit IV	**REFRIGERATION AND AIR CONDITINING INSTRUMENTS**	
Introduction – Gauge manifold – Rotameter – Thermometer – Stem type, Dial type thermocouple – Sling psychrometer – Anemometer – Tong tester – Energy meter-Ammeter – Voltmeter – Watt meter – Voltage variac.		3
Unit V	**BASIC ELECTRICAL IN REFRIGERATION**	
Motor Operating Components: Selector switch – OLP – Relay – Capacitor – Starting, Running. System Controls: LP, HP cutout – Oil pressure cutout – Water pressure cutout – Humidity control – Thermostat switch – Solenoid valve.		3

Practical Exercise

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

Ex. No	Name of the Exercise	Hours
1	Study and identification of various Refrigeration & Air conditioning tools	4
2	Cutting and flaring operation on copper tube	4
3	Swaging and brazing operation on copper tube	4
4	Bending, straightening and pinching operation on copper tube	4
5	Fabrication of circular duct	4
6	Fabrication of rectangular reducer duct	4
7	Determination of air flow velocity using anemometer	4
8	Determination of DBT and WBT of air using sling psychrometer	4
9	Testing of starting and running capacitor	4
10	Test the working condition of thermostat switch	4
	Practice + Continuous Test + Revision	20
	TOTAL HOURS	**75**

Suggested List of Students Activity:

Prepare/Download a specification of the following:

1. Various tools & Equipments in R&A/C workshop.
2. Various duct joints diagrams

Text and Reference Books:

1. Refrigeration and Air-conditioning by Arora and Domkundwar Dhanpat Rai & Sons Publication,
2. Refrigeration and Air-conditioning by Khurmi and Gupta, S.Chand Publications,

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

3. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
4. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
5. Refrigeration and Air Conditioning – C.P Arora, Tata McGraw Hill Education, 2000.

Web-based Online Resources:

- https://onlinecourses.nptel.ac.in/
- https://youtu.be/dfXQV3m63ag?si=CE3V7Yj5E4lNFx-9
- https://youtu.be/_kvuIF50yOA?si=OV2Rt6fxD9MFbqDR

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	**TOOLS AND EQUIPMENTS**	**Nos**
01	Flaring tool kit	1
02	Bracing setup	1
03	Duct fabrication setup	1
04	Anemometer	1
05	Sling psychrometer	1
06	Capacitor testing setup	1
07	Thermostat switch testing setup	1

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

Practical document should be submitted for the examination with a bonafide certificate.

1221233540	**R&A/C WORKSHOP**	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim	05
B	Procedure	10
C	Testing/execution of experiment/copper tube operation/duct fabrication	40
D	Result	05
E	Written Test (Theory Portion)	30
F	Viva voce	10
	TOTAL MARKS	**100**

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

1221233620	BASIC MANUFACTURING TECHNOLOGY PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

Introduction:

This practical subject is designed in such a way to gain adequate and through knowledge about the working of conventional as well as non-conventional machines. This subject inculcates the students about the skills of metal cutting, grinding, moulding, welding, welding related process and other machining processes which are very much essential for a technician that improves their employability

Course Objectives:

The objective of this course is to enable the student to

- Identify the parts of a center lathe, tools used in foundry and equipments used in welding
- Set the tools for various operations
- Operate the lathe and Machine a component using lathe
- Prepare sand moulds for different patterns.
- Perform welding operation to make different types of joints.

Course Outcomes:

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

CO1: prepare green sand mould for given pattern

CO2: perform welding operation and make butt and lap joints.

CO3: perform resistance welding operation and make lap joints and perform welding related process soldering.

CO4: perform plain and step turning operations in a center lathe

CO5: perform drilling, counter boring operations

Pre-requisites:

Nil

CO/PO Mapping

1221233620	**BASIC MANUFACTURING TECHNOLOGY PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

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

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 in a simulated environment, transitioning to real-world scenarios when possible

Assessment Methodology:

1221233620	BASIC MANUFACTURING TECHNOLOGY PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

	Continuous Assessment (40 marks)				End Semester Examination (60 marks)
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	50% Exercises	50% Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as 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.

1221233620	BASIC MANUFACTURING TECHNOLOGY PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim	05
B	Procedure	10
C	Execution / Dimensional accuracy	30
D	Result	05
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 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.

SCHEME OF EVALUATION

Part	Description	Marks

1221233620	BASIC MANUFACTURING TECHNOLOGY PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

A	Aim	10
B	Procedure	10
C	Execution / Dimensional accuracy	60
D	Result	10
E	Viva-voce	10
TOTAL MARKS		**100**

Syllabus Contents

PRACTICAL		
Ex. No	Name of the Exercise	Hours
1	Green sand moulding – single piece pattern	5
2	Green sand moulding – split pattern	5
3	Arc welding – lap joint	5
4	Arc welding – butt joint	5
5	Resistance welding- spot welding	5
6	Welding related process - soldering	5
7	Lathe operation – plain turning	5
8	Lathe operation – step turning	5
9	Drilling and counter-boring	5
10	Grinding - surface	5
Practice + Continuous Test + Revision		10

1221233620	**BASIC MANUFACTURING TECHNOLOGY PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2
TOTALHOURS					**60**

Suggested List of Students Activity:

1. Study and practice the green sand moulding for various component manufacturing 2. Field visit nearby industries based on CNC machines and make report

Textbook for reference:

1. Elements of workshop Technology Volume I & II – Hajra Chowdry & Bhattacharaya - IIth Edition - Media Promoters & Publishers Pvt. Ltd., Seewai Building `B‘, 20-G, Noshir Bharucha Marg, Mumbai 400 007 – 2007.
2. Introduction of basic manufacturing processes and workshop technology – Rajendersingh – New age International (P) Ltd. Publishers, 4835/24, Ansari Road, Daryaganj, New Delhi – 110002.
3. Manufacturing process – Begeman - 5^{th} Edition -McGraw Hill, New Delhi 1981.
4. Workshop Technology- WAJ Chapman - Volume I, II, & III – Vima Books Pvt. Ltd., 4262/3, Ansari Road, Daryaganj, New Delhi 110 002.

Web-based/Online Resources:

1. NPTEL
2. NITTTR

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl.No	Equipments	Nos
01	Center lathe 4.5’ bed length with lathe related tools	10

1221233620	BASIC MANUFACTURING TECHNOLOGY PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

02	Moulding box arrangement with single piece pattern and split pattern	10
03	Arc welding setup with welding related tools	2
04	Spot welding setup	1
05	Drilling machine with drill bits and tools	2
06	Grinding machine with tools	2

END SEMESTER EXAMINATION – PRACTICAL EXAM.

BOARD EXAMINATIONS

Note:

- All the exercises have to be completed, any one exercise will be given for examination.

1221233620	BASIC MANUFACTURING TECHNOLOGY PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

- 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	10
B	Procedure	10
C	Execution / Dimensional accuracy	60
D	Result	10
E	Viva-voce	10
TOTAL MARKS		**100**

1221234110	REFRIGERATION	L	T	P	C
THEORY		3	0	0	3

Introduction

This subject deals with the basic understanding of refrigeration, refrigeration methods. The content provides knowledge about refrigerants used in industry. Also, it is used to impart knowledge about low temperature applications.

Course Objectives

The objective of this course is to enable the student,

- Understand the basics of compression cycles & methods of producing low temperature.
- Understand basic concepts of vapour compression system and p-H t-S diagrams.
- Acquire knowledge of refrigerants and its environmental factors.
- Learn about low temperature.
- Understand the concepts of non-conventional refrigeration system

Course Outcomes

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

CO1: Unterstand the basics of refrigeration including cop and refrigeration effect.

CO2: Acquire knowledge in the working of vapour compression system and the thermodynamic cycle involved.

CO3: Understand various refrigerants, their properties and their environmental effects.

CO4: Acquire knowledge in low temperature systems and multi stage compression.

CO5: acquire knowledge in absorption systems.

Pre-requisites Nil

CO/PO Mapping

1221234110	REFRIGERATION	L	T	P	C
THEORY		3	0	0	3

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

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

Instructional Strategy

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

Assessment Methodology

1221234110	REFRIGERATION	L	T	P	C
THEORY		3	0	0	3

	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.

1221234110	REFRIGERATION	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 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 REFRIGERATION**	
Definition of refrigeration, refrigeration effect and COP – Unit of refrigeration. Engine – heat supplied, heat rejected, work output, thermal efficiency, refrigerator – thermal efficiency – heat absorbed, heat rejected, relative COP, work input, COP, Heat pump – Heat absorbed, heat delivered, work input, EPR. Reversed Carnot cycle – Bell Coleman cycle with COP- no derivation and no problems.		9
Unit II	**VAPOUR COMPRESSION REFRIGERATION SYSTEM**	
Simple vapour compression system – basic components -representation of p-h and T-s diagram with refrigeration effect, work of compression, heat rejection, saturated liquid and vapour line, sub cooled liquid region, superheated vapour region. Effect of liquid sub cooling and superheating, effect of varying suction and discharge pressure. -wet compression cycle with superheating and sub cooling - no derivation and no problems.		9

1221234110	REFRIGERATION	L	T	P	C
THEORY		3	0	0	3

Unit III	REFRIGERANTS

Refrigerant – classification of refrigerants – primary refrigerants - Halo carbon, chlorofluoro carbons, Hydrocarbons, hydrochloro carbons, hydro fluoro carbons, mixtures, azeotropes, Geotropes, near azeotropes, inorganic refrigerants – Properties – Thermodynamic & Thermo physical properties (list only) – Boiling point, freezing point, Evaporator and condenser pressure, critical temp. and pressure, Latent heat, specific volume, specific heat of vapour and liquid, thermal conductivity, dielectric strength- Secondary refrigerants – brine solutions. Safe working properties – Toxicity, flammability, corrosive property, chemical stability, effect on stored product – Environmental effects of Refrigerants- ozone depletion & global warming – total equivalent global warming impacts.	9

Unit IV	LOW TEMPERATURE REFRIGERATION

Limitations of vapour compression system –Multistage compression system – process, representation in p-h diagram, Advantages and limitations - two stage cascade system – Process and representation in p-h diagram – – advantages and applications of cascade system. Solid carbon dioxide – uses – economic production of solid CO2 process. Joule Thompson effect – inversion temperature – applications in liquefaction of gases. Linde System – working of Linde system – Claude system -Liquefaction of air by claude system - Production of liquid Hydrogen – Applications of low temperature.	9

Unit V	OTHER REFRIGERATION CYCLES

1221234110	REFRIGERATION	L	T	P	C
THEORY		3	0	0	3

Vapour absorption system – practical ammonia absorption system – Lithium Bromide System – Electrolux System – No derivation – No problems - Thermoelectric effects – see beck effect, peltier effect, Thomson effect. Required properties of thermoelectric materials in terms of electrical conductivity, thermal conductivity and rate of change of voltage with temperature. Thermoelectric refrigeration system – Advantages and disadvantages	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 components list of VCR system and its function.
2. Prepare list of refrigerants and its properties.
3. Presentation/Seminar by students on VCR system
4. Presentation/Seminar by students on VAR system

Reference Books:

1. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
2. Refrigeration and Air – Conditioning by Khurmi and Gupta, S.Chand Publications.
3. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.
4. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
5. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.

Web Reference

1221234110	REFRIGERATION	L	T	P	C
THEORY		3	0	0	3

- https://youtu.be/dUPotHWw94w?si=CTVw_kceaC-DpPgK
- https://youtu.be/lMqoKLli0Y4?si=1SrPHWVSAgvS9XP-
- NPTEL

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.

1221234230	FLUID MECHANICS AND MACHINES	L	T	P	C
PRACTICUM		2	0	2	3

Introduction:

Fluid Mechanics and Machines, this course will delver into the fundamental principles governing the behaviour of fluids including liquids and gases, and explore their application in various machines and engineering systems. From understanding fluid properties and behaviour to analyse the performance of pumps, turbines and other fluid machines. This Course provides the solid foundation to tackle the real-world engineering challenges.

Course Objectives:

The objective of this course is to enable the student to

- Introduce the fundamental concepts related to the properties of fluids • Understand the basic principles of fluid pressure measuring machines.
- Employ the concept of fluid machines and devices.
- Apply acquire knowledge on real life problems
- Analyse the existing fluid systems and design the new fluid systems in future.

Course Outcomes:

On successful completion of this course, the student will be able to CO1:
Understand the basics properties of fluids.
CO2: To Understand the transmission of pressure in liquids and its application to Hydraulics. CO3: To employ the concept of continuity of flow and use Bernoulli's equation to measure flow rate and velocity
CO4: To Understand the momentum of hydraulic pumps and its benefits CO5:
Acquire knowledge in Hydraulic Turbines and efficiency

Pre-requisites:

Knowledge in Basic Science

CO/PO Mapping

1221234230	**FLUID MECHANICS AND MACHINES**	L	T	P	C
PRACTICUM		2	0	2	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations, and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome- and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any.

1221234230	**FLUID MECHANICS AND MACHINES**	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

1221234230	FLUID MECHANICS AND MACHINES	L	T	P	C
PRACTICUM		2	0	2	3

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 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 log book 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

1221234230	FLUID MECHANICS AND MACHINES	L	T	P	C
PRACTICUM		2	0	2	3

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.

Syllabus Contents

Unit I	**PROPERTIES OF FLUIDS**
Theory: Fluid definition-classification- Properties density, specific gravity, specific weight, specific volume, dynamic viscosity, kinematic viscosity, surface tension, capillarity, vapor pressure and compressibility. definitions and units-pressure- -pressure head- Concepts of absolute, vacuum, gauge and atmospheric pressures-problems-Pascal's Law applications- Hydraulic press- Hydraulic jack.	6
Practical: **EX#01**Study of Hydraulic Press. **EX#02**Study of Hydraulic Jack.	6
Unit II	**PRESSURE MEASUREMENTS**
Theory: Piezometer-Simple U tube manometers and differential manometers and their types - problems-Mechanical gauges- Bourdon tube pressure gauge	4
Practical: **EX#03**Study of Piezometer in pressure measurements.	6

1221234230	FLUID MECHANICS AND MACHINES	L	T	P	C
PRACTICUM		2	0	2	3

EX#04 Study of Simple U tube Manometer.		
Unit III	**FLOW THROUGH PIPES**	
Theory: Types of Fluid flow- Laminar, turbulent, steady, unsteady, uniform, non-uniform, rotational, irrotational-mean velocity of flow- discharge-Continuity equation- energies of fluid-Bernoulli's theorem- Assumptions no derivation applications and limitations- Problems. Venturi meter- Construction working principle, coefficient of discharge-No derivation for discharge. Orifice meter- Construction working principle, coefficient of discharge no derivation for discharge Problems-hydraulic co Coefficients Cd, Cc and Cv.		6
Practical: **EX#05**Verify the Bernoulli's Theorem. **EX#06**Determination of the friction factor in a pipe.		6
Unit IV	**RECIPROCATING PUMPS AND CENTRIFUGAL PUMPS**	
Theory: Reciprocating Pumps and Centrifugal Pumps Reciprocating pumps- classification- construction and working of single acting reciprocating pump-discharge-theoretical power required-co- efficient discharge-slip- Air vessel-function and working Centrifugal pumps-classification-construction and working of single stage centrifugal pump.		5
Practical: **EX#07**Performance test on reciprocating pump and to draw the characteristics curves. **EX#08**Performance test on centrifugal pump and to draw the characteristics curves.		6
Unit V	**HYDRAULIC TURBINES**	

1221234230	**FLUID MECHANICS AND MACHINES**	L	T	P	C
PRACTICUM		2	0	2	3

Theory: Hydraulic Turbines-classifications- differences between impulse and	4
Reaction turbine-construction and working of Pelton wheel, Kaplan and Francis turbine-no derivations-no problems.	
Practical: **EX#09**Performance test on impulse turbine and to find out the Efficiency. **EX#10**Performance test on reaction turbine and to find out the Efficiency	6
Revision + Test + Students Activity	05
TOTAL HOURS	60

Suggested List of Students Activity:

1. Study on basic principles and concepts of fluid mechanics.
2. Study and demonstrate the performance and efficiency of hydraulic machines **Text and**

Reference books:

1. A Textbook of Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi Publications (P).,Ltd, New Delhi, 2010
2. Hydraulics and Fluid Mechanics, Modi P.N. and Seth, S.M. Standard Book House, New Delhi, 2013.
3. Fluid Power with Applications, Anthony Esposito,, Pearson Education 2005.
4. A Textbook of Fluid Mechanics, R. K Rajput, S.Chand & Co, New Delhi, 2019
5. Engineering Fluid Mechanics, Kumar K. L., Eurasia Publishing House (P) Ltd., New Delhi, 2016.

Web reference:

- NPTEL

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl.No	Equipments	Nos

1221234230	FLUID MECHANICS AND MACHINES	L	T	P	C
PRACTICUM		2	0	2	3

1	The Bernoulli's Apparatus.	01
2	An arrangement to find friction factor of pipe.	01
3	A reciprocating pump with an arrangement for collecting data to find out the efficiency and plot the characteristics curves.	01
4	A Centrifugal pump with an arrangement for collecting data to find out the efficiency and plot the characteristics curves.	01
5	An impulse turbine with an arrangement for collecting data to find out the efficiency.	01
6	A reaction turbine with an arrangement for calculating data to find out the efficiency.	01

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.

1221234230	**FLUID MECHANICS AND MACHINES**	L	T	P	C
PRACTICUM		2	0	2	3

1221234340	**HVAC CAD DRAWING**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

HVAC CAD drawing help to develop the technical hands-on skills required by the technicians working and various Engineering sectors. This course intends to impart the basics of AutoCAD tools and their uses in different sections of industrial drawing. The topics covered are based on the syllabus for diploma studies in Engineering. The course is planned to include basic practical experience in HVAC drawings. The courses are arranged in sequence, that starts from the basic concepts on Dimensioning system, and basic drawing tools in AutoCAD. In this course, it is expected that the students would be able to get CAD drawing in the fields of HVAC experience, which helps to build an understanding of the complexity of the industrial job and the skills requirement of the jobs.

Course Objectives:

The objective of this course is to enable the student to

- Study the basic R&A/C components.
- Draw the various R&A/C equipments symbol.
- Draw the various HVAC duct work symbols.
- Draw Compressor connection, Condenser connection and Evaporator connection used in HVAC field.
- Draw the process drawing for Split A/C, Chillers and Cooling tower
- Draw duct work drawing for a hall
- Draw the process drawing for a typical central A/C plant.

Course Outcomes:

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

CO1: Know and identify the basic R&A/C components and symbols used in HVAC drawings CO2: Know, identify and draw the compressor, condenser and evaporator connection in HVAC drawings CO3: Know, identify and draw the process of split A/C, chillers and cooling tower in HVAC drawings CO4: Know, identify and draw the process of a typical central A/C plant in HVAC drawings CO5: Know, identify and draw the duct work drawing in HVAC.

1221234340	**HVAC CAD DRAWING**	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites:

Nil.

CO/PO Mapping

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

1221234340	HVAC CAD DRAWING	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester
	CA1	**CA2**	**CA3**	**CA4**	**Examination (60 marks)**
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	Ex 1- any 5 for 15 marks ex 2, any 5 for 20 marks ex 3, any 6 for 25 marks	Ex 4, ex 5 and ex 6 any 2 connection drawing each 30 marks	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.

1221234340	HVAC CAD DRAWING	L	T	P	C
PRACTICUM		1	0	4	3

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

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

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 a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	Description	Marks
A	Drawing of basic R&A/C components – part1 (ANY 3)	10
B	Drawing of basic R&A/C components – part2 (ANY 3)	10
C	CONNECTION DRAWING (ANY TWO)	10
D	PROCESS DRAWING (ANY ONE)	20
E	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.

Question pattern – Written Test Theory

Description	Marks

1221234340	HVAC CAD DRAWING	L	T	P	C
PRACTICUM		1	0	4	3

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

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

Part	**Description**	**Marks**
A	Drawing of basic R&A/C components – part1 (ANY 3)	10
B	Drawing of basic R&A/C components – part2 (ANY 3)	10
C	CONNECTION DRAWING (ANY TWO)	15
D	PROCESS DRAWING (ANY ONE)	25
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

Syllabus Contents

1221234340	HVAC CAD DRAWING	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion		
Unit I	**BASICS OF AUTOCAD**	
Introduction- scope of HVAC drawings- overview of autocad– units-limit setting – basic autocad-commands- draw-edit-dimensioning-save-print out-syntax -explanations		3
Unit II	**STUDY OF BASIC R&A/C COMPONENTS & SYMBOLS AND BASIC R&A/C COMPONENTS – PART1**	
Introduction- Drawing of basic R&A/C components – part1 like HVAC equipments symbols like - FCU, AHU, chiller, pump, fan, cooling coil, compressor, silencer, muffler, air filter, drier, condenser, thermostat, dx unit, cooling tower, gate valve, globe valve, solenoid valve, butterfly valve, check valve- APLLICATIONS		2
Unit III	**BASIC R&A/C COMPONENTS – PART2**	
INTRODUCTION-HVAC duct work symbols like - straight duct, bend, branch duct, junction, y junction, 3-way junction, beveled junction, miter bend, transition, offset transition, diffuser supply & return, duct heater, flexible connection, flexible connector, damper, vav box, linear diffuser supply & return, floor register, louver opening, air grill-APPLICATIONS		2
Unit IV	**CONNECTION DRAWINGS**	
Introduction – compressor, condenser and evaporator – functions – applications – connections		3
Unit V	**PROCESS DRAWINGS**	
Introduction- explanation of process in split ac, central ac plant, chillers, cooling towers, duct systems-		5

Practical Exercise		
Ex. No	Name of the Exercise	Hours

1221234340	HVAC CAD DRAWING	L	T	P	C
PRACTICUM		1	0	4	3

1	Study of basic R&A/C components & symbols	4
2	Drawing of basic R&A/C components – part1 (HVAC equipments symbols like – FCU, AHU, chiller, pump, fan, cooling coil, compressor, silencer, muffler, air filter, drier, condenser, thermostat, dx unit, cooling tower, gate valve, globe valve, solenoid valve, butterfly valve, check valve)	4
3	Drawing of basic R&A/C components – part2 - (HVAC duct work symbols like - straight duct, bend, branch duct, junction, y junction, 3-way junction, beveled junction, miter bend, transition, offset transition, diffuser supply & return, duct heater, flexible connection, flexible connector, damper, VAV box, linear diffuser supply & return, floor register, louver opening, air grill)	5
4	Compressor connection drawing	4
5	Condenser connection drawing	4
6	Evaporator connection drawing	4
7	Process drawing – Split ac	4
8	Process drawing - Typical duct drawing for a hall	5
9	Process drawing- Chillers	5
10	Process drawing- Cooling tower	5
11	Process drawing - Typical central ac plant	6
	Practice + Continuous Test + Revision	10
	TOTAL HOURS	**75**

Suggested List of Students Activity:

1. Visit a HVAC industry and Prepare a CAD drafted drawings of
2. A typical hall AC drawing

1221234340	HVAC CAD DRAWING	L	T	P	C
PRACTICUM		1	0	4	3

3. Duct systems in a selected hall / area
4. Central AC plant with all components, with connection diagrams

Text and Reference Books:

1. HVAC system design handbook – 5th edition by Roger W Haines PW and Michael E Myers P E LEED AP Mc Graw Hill Publications
2. HVAC design & drafting as per ASHRAE by Mohamed Abdulaziz ACDEMIA

Web-based Online Resources:

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

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	TOOLS AND EQUIPMENTS	Nos
01	Personal computer	30
02	Printer	1
03	Required number of CAD package sufficient to the strength	---

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

Practical document should be submitted for the examination with a bonafide certificate.

SCHEME OF EVALUATION

Part	Description	Marks
A	Drawing of basic R&A/C components – part1 (ANY 3)	10

1221234340	**HVAC CAD DRAWING**	L	T	P	C
PRACTICUM		1	0	4	3

B	Drawing of basic R&A/C components – part2 (ANY 3)	10
C	CONNECTION DRAWING (ANY TWO)	15
D	PROCESS DRAWING (ANY ONE)	25
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

1020234440	SENSORS AND ACTUATORS	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Sensors are needed to measure (sense) unknown signals and parameters of an engineering system and its environment. Essentially, sensors are needed to monitor and learn about the system. Sensor is a device that when exposed to a physical phenomenon (temperature, displacement, force, etc.) produces a proportional output signal (electrical, mechanical, magnetic, etc.). Actuators are needed to drive a plant. A diploma holder when employed in automated industrial process controls will be required to know the basics of Sensors and Actuators.

Course Objectives:

The objective of this course is to enable the student to

- Explain the types and working of various types of sensors.
- Practice with temperature sensor, proximity sensor, LVDT and Light Sensors.
- Describe the functions of Linear and Rotary Electrical actuators.
- Describe the functions of Electrical, Pneumatic and Hydraulic actuators.
- Practice with interfacing of Arduino compatible sensors and actuator with Arduino.

Course Outcomes:

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

CO1: Describe the working of Resistive, Inductive, Temperature and Light Sensors.

CO2: Interface and observe the behaviour of Proximity sensors with relay and buzzer. CO3: Construct the circuit and observe the behaviour of the solid state electronic actuator.

CO4: Describe the working of Electrical, Pneumatic and Hydraulic actuators.

CO5: Demonstrate the applications of Arduino compatible sensors and actuators.

Pre-requisites:

Applied Physics, Basic Electrical and Mechanical Engineering.

CO/PO Mapping

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

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

Assessment Methodology:

	Continuous Assessment (40 marks)	**End Semester**

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

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

Note:

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

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

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

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

1020234440	SENSORS AND ACTUATORS	L	T	P	C
PRACTICUM		1	0	4	3

This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The student should draw the Circuit Diagram and take readings, do calculations and prepare the Graph/Result manually in the documents.

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	5
B	Circuit Diagram	20
C	Connections and Execution	25
TOTAL		50
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

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

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

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	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.

Syllabus Contents

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

Theory Portion

UNIT I: SENSORS	**Period**
Resistance, Inductance and Capacitive Sensors: Definition – Classification of Sensors/Transducers - Elements of measurement system – Primary Sensing Elements (Bellows, Bourdon Tube) - Potentiometer - Linear potentiometer – Rotary potentiometer - Load Cell – Strain Gauge Load Cell - Linear Variable Differential Transformer (LVDT) – Rotary - Variable Differential Transformer (RVDT) – DC Tachogenerator – AC Tachogenerator - Principles of Capacitive Sensors – Hall effect sensor. Temperature Sensors: Thermocouple – Resistance Temperature Detector – Thermistor - Infrared (IR) thermometer. Proximity Sensors: Inductive Proximity Sensor – Capacitive Proximity Sensor - Photoelectric Proximity Sensor - Ultrasonic Proximity Sensor - Basic Reed Switch. Light Sensor: Photodiode – Phototransistor – Photoconductive Cell - Photovoltaic Cells - Bar Code Reader - Shaft Encoders - Encoder Types (Incremental Encoder, Absolute Encoder) - Optical Shaft Encoder - Photoelectric Tachometer. Arduino Compatible Sensor : Voltage Sensor – Current Sensor – LM35 Sensor - Ultrasonic Sensor - Force Sensor – Moisture Sensor – Gas Sensor.	**8**

Practical Exercises:

Ex.No	**Name of the Experiment**	**Period**
1.	TEMPERATURE MEASUREMENT Activities to Perform: i) Construct a circuit to measure Temperature of Liquid using Thermistor or Thermocouple or RTD. ii) Also find the graphical relationship between input and output.	**4**

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

2.	BEHAVIOUR OF PROXIMITY SENSORS Activities to Perform: i)Observe the behaviour of Inductive proximity sensor and Capacitive Proximity sensor for different material samples. ii)Interface relay and buzzer with sensors to test the output.	**4**
3.	LVDT Activities to Perform: i) Construct a circuit for Measurement of Linear Displacement using LVDT. ii) Find the graphical relationship between input and output.	**4**
4.	PERFORMANCE OF LIGHT SENSOR Activities to Perform: i) Construct a circuit to obtain the VI characteristics and Response Characteristics of Photoconductive Cell (LDR). ii) Construct a circuit to measure the speed of the motor using Optical Sensor.	**4**
5.	PERFORMANCE OFULTRASONIC AND MOISTURE SENSORS Activities to Perform: i)Interface Ultrasonic sensor with Arduino and measure the distance of the object. ii)Interface Moisture sensor with Arduino and measure the moisture content in the soil.	**4**

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

UNIT II: ACTUATORS	
Electrical Actuators: General aspects - Switching Devices – Mechanical Switches (Push button – SPST –SPDT – Limit Switch – Solenoid – Relays) – Solid State switches (Diode, Transistor and Thyristor) – DC Motors – AC Motors – Stepper Motors – Servo Motors. Pneumatic Actuators: Introduction – Components of a Pneumatic Systems –Linear actuators – Construction and working of Single acting and Double acting cylinders - Rotary Actuators – Air Motors – Types of Air Motors - Piston type Motor, Vane Motor, Turbine Motor - Applications of Air Motors. Hydraulic Actuators: Hydraulic Power Supply - Components of Hydraulic system - Linear actuators - Construction and working of Single acting and Double acting cylinders – Applications of Hydraulic Cylinders - Some example mechanism driven by an Hydraulic cylinders - Rotary Actuators – Hydraulic Motors – Advantages and Applications of Hydraulic Motors.	**7**

Practical Exercises:

Ex.No	**Name of the Experiment**	**Period**
6.	OBSERVE THE BEHAVIOUR OF TRANSISTOR AS A SWITCH Activities to Perform: i) Construct a circuit to get ON/OFF control on DC Motor using Push Button, SPST, SPDT and Limit Switch. ii) Construct a circuit to get ON/OFF control on DC Motor using Transistor and Relay.	**4**

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

7.	FORWARD AND REVERSE CONTROL OF AC MOTOR Activities to Perform: i) Connect Forward Reverse Control switch to change the direction of rotation of three phase induction motor. ii) Demonstrate the Forward and Reverse operation of Motor.	**4**
	iii)Measure the No-Load current in each phase using Tongue tester (Clamp Meter).	
8.	PNEUMATIC CIRCUIT FOR DOUBLE ACTING CYLINDER Activities to Perform: i) Construct a Pneumatic Circuit to control double acting pneumatic cylinder using 5/2 Solenoid Valve. ii) Discuss the behaviour of cylinder as linear actuator.	**4**
9.	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**
10.	SERVO MOTOR CONTROL WITH AN ARDUINO Activities to Perform: i) Construct an Arduino based circuit to sweeps the shaft of servo motor back and forth across 180 degree. ii) Interface potentiometer with Arduino and based on its position get the control of servo motor shaft.	**4**
	Revision + Test + Practice	**20**
	Total	**75**

1020234440	SENSORS AND ACTUATORS	L	T	P	C
PRACTICUM		1	0	4	3

Suggested List of Students Activity:

1. Activity 1 : Each student writes and submits the assignment on the topic Basics of Electricity, Ohm's Law and Electromagnetism.
2. Activity 2 : Four students can be grouped as a batch and practice an additional experiment to interface any one of the Arduino compatible sensors (LM35 Temperature sensor, Force Sensor, Gas Sensor, Voltage Sensor, Humidity Sensor, Rain Sensor, Acceleration sensor, magnetic sensor, Infrared sensor etc.,) with Arduino and observe the behaviour of sensors.

Text book for Reference:

1. D. Patranabis, Sensors and Transducers, Multicolour Edition, Second Edition, PHI Learning Private Limited., 2013.
2. Er. R.K. Rajput, A Textbook of Mechatronics, Fourth Edition, S. Chand & Co., 2016.
3. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs and Application, Fourth edition, Springer, 2010.
4. Massood Tabib and Azar, Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures, First edition, Kluwer academic publishers, Springer, 1997.

Web-based/Online Resources:

- https://archive.nptel.ac.in/courses/108/108/108108147/
- https://www.youtube.com/watch?v=H9OEAn3Uc2w
  ●https://www.youtube.com/watch?v=Ab9U7NQB1kA **Equipment / Facilities required to conduct the Practical Course.**

S.No	Name of the Equipment's	Quantity Required
1.	Temperature Measurement using Thermocouple / Thermistor / RTD Kit	1 No

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

2.	Inductive and Capacitive Proximity Sensors, Relay, Buzzer, Suitable Power Supply Unit	Each 1 No
3.	LVDT Trainer Kit	1 No
4.	LDR, MC Ammeter and Voltmeter, 0-30V DC Power Supply Unit, DC Motor with Optical Sensor set up	Each 1 No
5.	Arduino Shield, Arduino compatible Ultrasonic Sensor and Moisture sensor	Each 1 No
6.	Push Button, SPST, SPDT, Limit Switch, Low Voltage DC Motor, Transistor and Relay	Each 1 No
7.	3 Phase Induction Motor, Forward Reverse Control switch and Clamp Meter	Each 1 No
8.	Double acting Pneumatic cylinder, Directional Control Valve, Compressor	Each 1 No
9.	Hydraulic Motor, Control Valve, Hydraulic Power Bank	Each 1 No
10.	Arduino shield, Arduino compatible Servo Motor and Potentiometer	Each 1 No
11.	Other Consumables	As Required

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

Note:

1020234440	**SENSORS AND ACTUATORS**	L	T	P	C
PRACTICUM		1	0	4	3

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 & 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.

1221234520	**REFRIGERATION PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

Introduction:

This subject refrigeration practical help to develop the skills required by the technicians working in various R&A/C sectors. This course intends to impart the various tests to be conducted in the refrigeration fields. The topics covered are based on their syllabus for diploma studies in R&A/C engineering. The contents include the gauge manifold set installation and working of service valves. The energy efficiency concept is achieved by testing the system for its percentage running time of refrigeration system. Experiments to be conducted in refrigeration system and the COP determinations are to be calculated. The CSR terminals of the compressor are to be found out by conducting tests. Different starting circuits of compressor motor are to be studied and experiments are to be conducted. These contents help to improve the technical skills and experimentation and capacity calculation skills for the students.

Course Objectives:

The objective of this course is to enable the student to

- Install gauge manifold set in refrigeration system and understand the working of service valves.
- Find percentage running time of refrigerator for energy efficiency • Determine COP, Refrigeration effect and Capacity of sealed system.
- Determine Actual COP and Capacity of open system.
- Identify CSR terminals of hermetic compressor, electrical circuits and components of a refrigeration system.
- Understand the different starting circuits of refrigeration system

Course Outcomes:

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

CO1: Handle gauge manifold set and service valves in refrigeration system

CO2: Calculate percentage running time of a refrigerator

CO3: Calculate COP, Refrigeration effect and Capacity of sealed and open type system.

CO4: Understand the working of electrical circuits and components in a refrigeration system

1221234520	REFRIGERATION PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

CO5: Understand the working of different starting circuits of a refrigeration system

Pre-requisites:

Nil

CO/PO Mapping

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

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.

1221234520	**REFRIGERATION PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

- 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 in a simulated environment, transitioning to real-world scenarios when possible **Assessment Methodology:**

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	50% Exercises	50% Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as 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.

1221234520	**REFRIGERATION PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim & Procedure	10
B	Observation / Calculation / Fault diagnosis	15
C	Execution	15
D	Result	10
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 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.

SCHEME OF EVALUATION

Part	**Description**	**Marks**

1221234520	REFRIGERATION PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

A	Aim & Procedure	15
B	Observation / Calculation / Fault diagnosis	30
C	Execution	35
D	Result	10
E	Viva-voce	10
TOTAL MARKS		**100**

Syllabus Contents

PRACTICAL		
Ex. No	Name of the Exercise	Hours
1	Study of service valves and installation of gauge manifold set in open type system test rig	4
2	Determination of percentage running time of a refrigerator for a typical thermostat setting	4
3	Determination of COP, Refrigeration effect & Capacity of sealed system	4
4	Determination of Capacity and actual COP of open type system with capillary tube as expansion device	4
5	Determination of Capacity and actual COP of open type system with automatic expansion valve as expansion device	4
6	Determination of Capacity and actual COP of open type system with TEV as expansion device	4
7	Test on OLP, current coil relay and PTC relay of a refrigeration system	4
8	Electrical circuit of refrigerator and water cooler	4

1221234520	REFRIGERATION PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

9	Determination of CSR terminal of a refrigeration compressor	4
10	Wiring, Starting and Running of refrigeration system with RSIR starting circuit.	4
11	Wiring, Starting and Running of refrigeration system with CSIR starting circuit.	4
12	Fault diagnosis & remedies of a refrigerator.	4
Practice + Continuous Test + Revision		12
TOTALHOURS		**60**

Suggested List of Students Activity:

1. Study and practice the electrical circuits for compressor connections 2. Study the applications of open type systems in a typical industry

Textbook for reference:

1. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
2. Refrigeration and Air – Conditioning by Khurmi and Gupta, S.Chand Publications.
3. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.
4. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
5. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001

Web-based/Online Resources:

- https://youtu.be/dUPotHWw94w?si=CTVw_kceaC-DpPgK
- https://youtu.be/lMqoKLli0Y4?si=1SrPHWVSAgvS9XP-
- NPTEL

1221234520	**REFRIGERATION PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl.No	Equipments	Nos
01	Open type VCR system with service valve	1
02	Gauge manifold set	1
03	Refrigerator test setup for percentage running time	1
04	Sealed VCR system test rig	1
05	Open type VCR system test rig with capillary tube, AEV and TEV	1
06	Experimental setup for testing OLP, current coil relay and PTC relay	1
07	Refrigerator	1
08	Water cooler	1
09	Hermetically sealed compressor	1
10	Multimeter	1
11	Refrigeration compressor with RSIR starting system	1
12	Refrigeration compressor with CSIR starting system	1

END SEMESTER EXAMINATION – PRACTICAL EXAM.

1221234520	**REFRIGERATION PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

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 & Procedure	15
B	Observation / Calculation / Fault diagnosis	30
C	Execution	35
D	Result	10
E	Viva-voce	10
TOTAL MARKS		**100**

1020234640	**METROLOGY AND MEASUREMENTS**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

The progress in metrology and measurements is highly necessary and has led to improvements in product quality, enhanced scientific research capabilities, and increased efficiency in diverse industries including manufacturing, automobile, aerospace, and quality control. It encompasses various disciplines and techniques used to ensure the accuracy, precision, and reliability of measurements. Therefore, the study of metrology and measurements is essential for maintaining uniformity and excellence across various fields, including manufacturing and scientific research.

Course Objectives

The objective of this course is to prepare the student,

- To impart knowledge about different measuring instruments.
- To provide fundamental principles of metrology and understand the significance of accurate measurements.
- To acquire knowledge regarding the measurement of linear and angular dimensions of components and assemblies.
- To impart knowledge on advanced measurement techniques for quality control in manufacturing industries

Course Outcomes

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

CO1: Classify the measuring instruments based on their applications.

CO2: Select appropriate instrument for linear dimensions

CO3: Select appropriate instrument for angular dimensions

CO4: Explain various instruments used in measuring screw threads and gears

CO5: Discuss about the applications of CMM and LASER technology in metrology

Pre-requisites

Knowledge of basic measuring instruments.

1020234640	**METROLOGY AND MEASUREMENTS**	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping

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

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

Instructional Strategy

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

Assessment Methodology:

1020234640	METROLOGY AND MEASUREMENTS	L	T	P	C
PRACTICUM		1	0	4	3

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

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

1020234640	METROLOGY AND MEASUREMENTS	L	T	P	C
PRACTICUM		1	0	4	3

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 log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	10
B	Observation / Dimensions	20
C	Accuracy	20
TOTAL		50
D	Practical Documents (As per the portions)	10
		60

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

Cycle - II Exercise 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.

1020234640	METROLOGY AND MEASUREMENTS	L	T	P	C
PRACTICUM		1	0	4	3

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

●**CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	10
B	Observation / Dimensions	20
C	Accuracy	20
D	Result	10
E	Viva voce	10
F	Written test	30
		100

1020234640	**METROLOGY AND MEASUREMENTS**	L	T	P	C
PRACTICUM		1	0	4	3

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

Syllabus contents

1020234640	**METROLOGY AND MEASUREMENTS**	L	T	P	C
PRACTICUM		1	0	4	3

THEORY	
UNIT I: LINEAR MEASUREMENTS AND COMPARATORS	**Periods**
Basics of Metrology Scope of Metrology, basic units, important terminology, Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; international standardization, the bureau of Indian standards - important elements of measurements - methods of measurements. Precision - accuracy - definition - factors affecting the accuracy of the measuring system - general rules for accurate measurements - precautions for use of instruments so as to avoid in accuracy in measurements - reliability – definition, Measurement uncertainty, Measurement system analysis, Compare systematic error and random error, Selection of measuring instruments - Calibration of measuring instruments. **Linear Measurements** Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, possible sources of errors in micrometers – slip gauges - requirements – Indian standard – care and use. **Comparator** Comparators – Working and advantages - Types - Mechanical and Pneumatic Comparators.	8

Practical Exercises:		
Ex. No	**Name of the Experiment**	**Hours**

1020234640	METROLOGY AND MEASUREMENTS	L	T	P	C
PRACTICUM		1	0	4	3

1	VERNIER CALIPER i) Measure the dimensions of ground MS flat/Cylindrical bush using Vernier Caliper. ii) Compare the results with Digital Vernier Caliper.	5
2	OUTSIDE MICROMETER i) Measure the diameter of a wire using micrometer ii) Compare the results with a digital Outside micrometer.	5
3	INSIDE MICROMETER i) Measure the inside diameter of the bore of a bush cylindrical component using Inside micrometer ii) Compare the results with digital inside micrometer.	5
4	SLIP GAUGES Measure the thickness of ground MS plates using slip gauges.	5
5	VERNIER HEIGHT GAUGE Measure the height of gauge blocks or parallel bars using vernier height gauge.	5
6	MECHANICAL COMPARATOR Find out the measurement of a given component and Compare with a standard component using a mechanical comparator and slip gauge.	5
THEORY		
UNIT II: ANGULAR MEASUREMENTS, CMM, SURFACE & ADVANCED METROLOGY		

1020234640	METROLOGY AND MEASUREMENTS	L	T	P	C
PRACTICUM		1	0	4	3

Angular Measurements: Angular measuring instruments – Bevel protractor, Angle gauges, Precision level, Sine bar, Autocollimator. Opto-mechanical measurements using a measuring microscope and Profile projector. Measurement of Screw threads – Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead. **Coordinating measuring Machine:** Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications. **Advanced Metrology:** Basic concepts of lasers - types of lasers - laser and LED based distance measuring instruments.	7

Practical Exercises:		
Ex. No.	**Name of the Experiment**	
7	UNIVERSAL BEVEL PROTRACTOR Measure the angle of a V-block/Taper Shank of Drill/ Dovetail using universal bevel protractor.	5
8	SINE BAR Measure the angle of the machined surface using sine bar with slip gauges.	5
9	SCREW THREAD MICROMETER Measure the geometrical dimensions of V-Thread using screw thread micrometer.	5
10	GEAR TOOTH VERNIER CALIPER Measure the geometrical dimensions of spur gear using gear tooth vernier caliper.	5
	Activity + Revision + Assessment Test	10

1020234640	**METROLOGY AND MEASUREMENTS**	L	T	P	C
PRACTICUM		1	0	4	3

Total	75

Suggested List of Student Activity

1. Each student writes and submits the assignment on the topic of Methods of measurements, Precautions to avoid inaccuracy in measurements, Selection and Calibration of measuring instruments.
2. Four students can be grouped as a batch to measure the various dimensions of taper shank drill bit and spur gear and submit the activity report. The activity report should have the diagram and various dimensions of the taper shank drill bit and spur gear.
3. Visit Industry to study the working of the CMM. Prepare a report.
4. Visit Industry to study the working of the Profile Projector. Prepare a report.
5. Study the various types of Comparator. Prepare a report.

Text and Reference books.

1. R. K. Jain, Engineering Metrology, 22 nd Edition, Khanna Publishers, 2022.
2. N. V. Raghavendra and L. Krishnamurthy, Engineering Metrology and Measurements, Oxford University Press India, 2013.
3. R. K. Rajput, Engineering Metrology and Instrumentation, S.K. Kataria & Sons, 2nd Edition, 2013.
4. Samir Mekid, Metrology and Instrumentation: Practical Applications for Engineering and Manufacturing, John Wiley & Sons, Inc., 2021.
5. Anand K. Bewoor & Vinay A. Kulkarni, Metrology & measurement, Tata McGraw-Hill, 2009.
6. Rega Rajendra, Principles of Engineering Metrology, Jaico Publishing House, 2008.

Web-based/Online Resources

●https://archive.nptel.ac.in/courses/112/104/112104250/

1020234640	**METROLOGY AND MEASUREMENTS**	L	T	P	C
PRACTICUM		1	0	4	3

END SEMESTER EXAMINATIONS – PRACTICAL EXAM.

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	10
B	Observation / Dimensions	20
C	Accuracy	20
D	Result	10
E	Viva voce	10
F	Written test	30
		100

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

LIST OF EQUIPMENTS

S. No	**Name of the Equipment**	**Quantity required**
1	Vernier Caliper	2 nos
2	Digital Vernier Caliper	2 nos
3	Outside Micrometer	2 nos
4	Digital Outside Micrometer	2 nos

1020234640	METROLOGY AND MEASUREMENTS	L	T	P	C
PRACTICUM		1	0	4	3

5	Inside Micrometer	2 nos
6	Digital Inside Micrometer	2 nos
7	Slip Gauges	2 nos
8	Vernier Height Gauge	1 no
9	Surface Plate	2 nos
10	Dial Indicator (0-10)	2 nos
11	Universal Bevel Protractor	2 nos
12	Sine Bar with Slip gauges	2 nos
13	Screw Thread Micrometer	2 nos
14	Gear Tooth Vernier Caliper	1 no
15	Mechanical Comparator	1 No.
	Consumable	Sufficient Quantity

1221235130	**AIR CONDITIONING**	L	T	P	C
PRACTICUM		3	0	2	4

Introduction:

Air conditioning is a combined process that performs many functions simultaneously. It conditions the air, transports it, and introduces it to the conditioned space. It provides heating and cooling from its central plant or rooftop units. It also controls and maintains the temperature, humidity, air movement, air cleanliness, sound level, and pressure difference in a space within predetermined limits for the comfort and health of the occupants of the conditioned space or for the purpose of product processing.

Course Objectives:

The objective of this course is to enable the student to

- Understand the basic concepts of Psychrometry (air properties) and instruments used for measuring DBT and WBT.
- Learn about Psychrometric processes such as heating, cooling, humidification, dehumidification and mixing of air streams
- Acquire knowledge about indoor air quality
- Study about basics of various air conditioning systems
- Learn the cooling load estimation

Course Outcomes:

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

CO1: Solve Psychrometric properties using steam tables and Psychrometric chart

CO2: Solve Outlet condition of air for various Psychrometric processes

CO3: Explain indoor Air-Quality for human comfort

CO4: Explain construction and working principle of various Air-Conditioning systems

CO5: Calculate cooling load, refrigeration effect and COP of an air conditioner

Pre-requisites:

Knowledge in Thermodynamics and Refrigeration.

CO/PO Mapping

1221235130	AIR CONDITIONING	L	T	P	C
PRACTICUM		3	0	2	4

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations, and real- world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome- and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).
- Do not let students work on an activity or an experiment with the expected outcome, rather allow students to be honest about whatever the results of the experiment are. If the results are different from the expectations, students should do an analysis where could be the source of error, if any.

1221235130	**AIR CONDITIONING**	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

1221235130	AIR CONDITIONING	L	T	P	C
PRACTICUM		3	0	2	4

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 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 log book 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 / Tabulation and Observation / Detailed study and explanation	20
C	Formula / Calculation	25
D	Result / Graph	05
E	Practical document (All Practicals)	30

1221235130	AIR CONDITIONING	L	T	P	C
PRACTICUM		3	0	2	4

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.

Syllabus Contents

Unit I	**PSYCHROMETRY, PSYCHROMETRIC RELATIONS**
Theory: Psychrometry-definition–dry air, moisture, moist air, psychrometric properties, dry bulb temperature (DBT), wet bulb temperature (WBT), dew point temperature (DPT), specific humidity (or) humidity ratio, absolute humidity, relative humidity, degree of saturation, humid specific volume, total heat of air – sensible heat of air, latent heat of water vapour, enthalpy of moist air. Psychrometric relations – applications of Dalton‘s law of partial pressure to moist air, relationship between specific humidity, partial pressure of water vapor and total pressure of moist air. Simple problems – Calculation of air properties.	7
Practical: **Ex#:01** Determination of air properties by using sling psychrometer reading and using psychrometric chart **Ex#:02** Study of Dalton’s law of partial pressure applied to moist air.	6
Unit II	**PSYCHROMETERS AND PSYCHROMETRIC PROCESSES I**

1221235130	AIR CONDITIONING	L	T	P	C
PRACTICUM		3	0	2	4

Theory: **2.1 PSYCHROMETERS** Psychrometers – Laboratory Psychrometers, sling psychrometer, aspirating Psychrometers -Psychrometric chart – representation of psychrometric properties- DBT lines, specific humidity lines, constant RH lines, constant specific volume lines, constant enthalpy lines, constant WBT lines. **2.2 PSYCHROMETRIC PROCESSES** Psychrometric processes - mixing of air streams, sensible heating, sensible cooling, Humidification and Dehumidification-Simple problems.	7
Practical: **Ex#:03** Study ofvarious psychrometers used in air conditioning **Ex#:04** Study of various lines in psychrometric chart	6

Unit III	**PSYCHROMETRIC PROCESSES II AND COOLING LOAD ESTIMATION**	
Theory: 3.1Cooling with dehumidification, cooling with adiabatic humidification of air, adiabatic chemical dehumidification, humidification by steam injection, heating and humidification - By pass factor. 3.2 Cooling load estimation Heat load calculations Cooling load calculation: Heat loads – sensible heat load and latent heat load Sensible heat load – wall gain load, sun load, sensible heat load from occupants, electrical equipment load, infiltration air and ventilation load, miscellaneous heat loads due to duct heat gain and fan load, fresh air load. Latent heat load –infiltrated air, ventilated air, latent heat load from occupants, load from hot cooked foods and stored materials, moisture gain through permeable walls and ceilings. -Only theory No problems		**8**

1221235130	AIR CONDITIONING	L	T	P	C
PRACTICUM		3	0	2	4

Practical: **Ex#:05** Study of sensible heating, sensible cooling and cooling with dehumidification process.	6
Ex#:06 Determination of cooling load for a typical classroom or library	
Unit IV **INDOOR AIR QUALITY**	
Theory: Human comfort: Requirements of comfort air conditioning – Oxygen supply, heat removal, moisture removal, air motion, purity of air– adaption of human body to variable climatic conditions, human body as thermal machine, thermal efficiency of human body, metabolic heat production, convective heat loss from body, heat lost by evaporation, radiation heat loss from body – ventilation standards for different A/C conditions - Effect of heat on work performance. Comfort and comfort chart – effective Temperature, factors governing optimum effective temperature.	7
Practical: **Ex#:07** Study of effect of heat on work performance. **Ex#:08** Study of factors governing optimum effective temperature.	6
Unit V **AIR CONDITIONING SYSTEMS**	
Theory: Types of air conditioning systems- Window air conditioner –Split air conditioner – packaged air conditioner - Central air conditioning system – Unitary air conditioning systems – Factory air conditioning system –Summer air conditioning systems –Winter air conditioning -Year round air conditioning- chiller plant-VRF Systems-	6
Practical **Ex#:09** Determination of capacity and COP of window air conditioner **Ex#:10** Determination of capacity and COP of split air conditioner	6

1221235130	AIR CONDITIONING	L	T	P	C
PRACTICUM		3	0	2	4

Revision + Test + Students Activity	10
TOTAL HOURS	75

Suggested List of Students Activity:

1. Presentation/Seminars by students based on fundamentals of thermodynamics and heat transfer
2. Periodical quizzes conducted on a weekly/fortnightly basis to reinforce the basic concepts

Text and Reference books:

1. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
2. Refrigeration and Air – Conditioning by Khurmi and Gupta, S.Chand Publications.
3. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.
4. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
5. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.

Web reference:

- NPTEL

Equipment / Facilities required to conduct the Practical Portions.

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl.No	Equipments	Nos
01	Sling psychrometers	2
02	Window air conditioner test rig	1
03	Split air conditioner test rig	1

1221235130	**AIR CONDITIONING**	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. Use of steam tables and psychrometric charts permitted in board examinations.

1221235130	**AIR CONDITIONING**	L	T	P	C
PRACTICUM		3	0	2	4

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 suit the 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.

Assessment Methodology:

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

	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 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 log book 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

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

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.

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.		9
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).		

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

PRACTICAL EXERCISES **20 Periods**

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

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

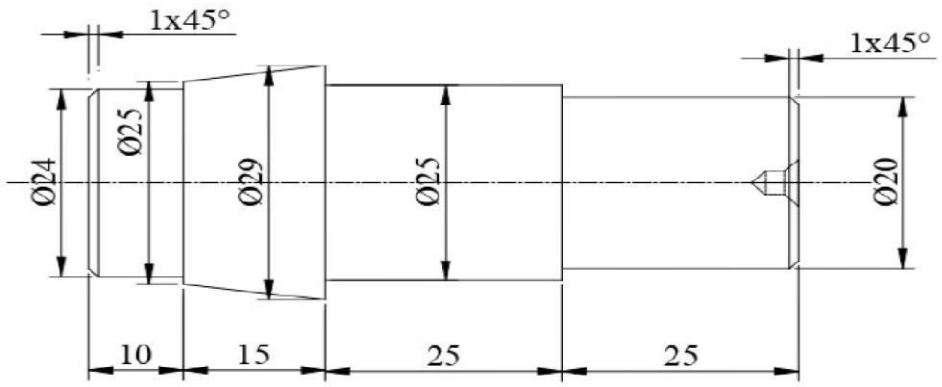
- To bring the saddle back and rearrange it 0.5 min
- To carry out threading work on the job. 1.5 min
- Inspection of the job. 1 min
- To remove the job from the lathe chuck. 0.5 min
- Carrying completed work piece to store 1 min

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.



$$Basictime = Observedtime \times Ratingofworker / StandardRating$$

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.

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

$$\%TIMESAVED = \frac{AVERAGETIMETAKENFORANASSEMBLYOLDMETHOD - AVERAGETIMETAKENFORANASSEMBLYNE}{AVERAGETIMETAKENFORANASSEMBLYOLDMETHOD}$$

APPARATUS REQUIRED:

1. Stop watch
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 stop watch 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.

Web-based Online Resources

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

- 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.

1221235311	ELECTIVE -1 HEATING SYSTEM	L	T	P	C
THEORY		3	0	0	3

Introduction

Heating system is mainly applied in majority of the colder countries. In colder countries comfort conditions are achieved through employing heating systems in residential as well as industrial buildings. In this course warm air heating system, hot water heating system, steam heating system, panel heating system and electric heating system. Since the application of heating system widely used in colder countries for the comfort of the people and process industries. It is very essential to study the different heating systems

Course Objectives

The objective of this course is to enable the student,

- Understand the requirements of heating systems
- Understand the concepts of warm air heating system
- Acquire knowledge in hot water heating system
- Study about the steam heating system
- Understand the concepts of panel heating system and electric heating system

Course Outcomes

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

CO1: Explain the requirements of heating systems

CO2: Demonstrate the concepts of warm air heating system

CO3: Describe the hot water heating system

CO4: Demonstrate the steam heating system

CO5: Explain the concepts of panel heating system and electric heating system

Pre-requisites

Basic knowledge in thermodynamics

1221235311	ELECTIVE -1 HEATING SYSTEM	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping

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

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

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a 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.

1221235311	ELECTIVE -1 HEATING SYSTEM	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology

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

1221235311	ELECTIVE -1 HEATING SYSTEM	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 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	**WARM AIR FURNACE SYSTEM**	
Introduction – types of heating system – classification of heating system- warm air furnace system, hot water heating system, steam heating system- working of warm air heating system with natural circulation – advantages and disadvantages of warm air furnace heating. Forced warm air system – classification – perimeter loop system, perimeter radial system and blend air system. Working of perimeter loop system, perimeter radial system and blend air system. Advantages of forced circulation system over natural circulation system		9
Unit II	**HOT WATER HEATING SYSTEM**	
Introduction - Working of hot water heating system for residence. Types of piping arrangement used for hot water heating system – one pipe system, two pipe system, over head tank with one pipe system and over head two pipe system. Working of high temperature water heating system. Advantages and disadvantages of water heating system		9

1221235311	ELECTIVE -1 HEATING SYSTEM	L	T	P	C
THEORY		3	0	0	3

Unit III	**STEAM HEATING SYSTEM**
Introduction – functions of steam heating system – classification of steam heating system based on piping arrangement – one pipe gravity return system, two pipe gravity return system, vapour type gravity return system and vacuum system with vacuum pump. Based on steam supply – high, medium and low. Based on condensate flow gravity, mechanical type. Working of one pipe gravity return system, two pipe gravity return system, vapour system and vacuum system with vacuum pump. Advantages and disadvantages of steam heating system	9
Unit IV	**PANEL HEATING SYSTEM**
Introduction – types of panels – hot water panel system, hot air panel system, electric panel heatings. Coil arrangement in panel system – continuous type, grid type and combination of continuous and grid type. Heating medium for panels – air as heating medium and water as heating medium. Location of panel – ceiling panels, floor panels and wall panels. Panel control, pipe arrangement for panel system. Advantages and disadvantages of panel heating system.	9
Unit V	**ELECTRIC HEATING SYSTEM**
Introduction – advantages of electrical panel heating system over conventional heating system. Control of electric heating system – single stage two position control, step controller, proportional control (variable autotransformer and saturable core reactor) and time proportioning control. Warm air curtains – arrangement of typical warm air curtain plant	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.**

1221235311	ELECTIVE -1 HEATING SYSTEM	L	T	P	C
THEORY		3	0	0	3

Suggested list of Students Activity,

1. Prepare a document containing all types of heating system.
2. Presentation/Seminar by students on Warm Air Furnace system.
3. Presentation/Seminar by students on Panel Heating system.
4. Presentation/Seminar by students on Steam Heating System.

Reference Books:

1.Refrigeration & Air Conditioning – Domkundwar & Arrora Dhanpat Rai & Sons Publications.

2.Ashrae journal

Web Reference

- NPTEL

1221235311	ELECTIVE -1 HEATING SYSTEM	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.

1221235312	ELECTIVE -1 HVAC MACHINES	L	T	P	C
THEORY		3	0	0	3

Introduction

This subject dealt with the basic understanding of refrigeration and air conditioning machines like compressor, condenser, expansion device and evaporator. The content provides knowledge about cooling tower, fans and blowers used in industry. Also, it is used to impart knowledge about various types of filters used in air conditioning field.

Course Objectives

The objective of this course is to enable the student,

- Understand the construction and working of various types of compressors.
- Acquire knowledge of different types of condensers and cooling towers.
- Understand basic concepts of expansion devices and evaporators.
- Learn about the industrial applications of fans and blowers.
- Understand the concepts of various types of filters.

Course Outcomes

After successful completion of this course, the students should be able to CO1: Understand the operations of different types of compressors.

CO2: Acquire knowledge in the working of condensers and cooling towers.

CO3: Understand the working of various expansion devices and evaporators.

CO4: Know the importance of fans and blowers.

CO5: Acquire knowledge in the usefulness of air filters in air conditioning applications.

Pre-requisites

Basic knowledge in VCR system and its components

CO/PO Mapping

1221235312	**ELECTIVE -1 HVAC MACHINES**	L	T	P	C
THEORY		3	0	0	3

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

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

Instructional Strategy

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

Assessment Methodology

1221235312	**ELECTIVE -1 HVAC MACHINES**	L	T	P	C
THEORY		3	0	0	3

	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.

1221235312	**ELECTIVE -1 HVAC MACHINES**	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 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	**COMPRESSOR**	
	Compressor - Introduction - Main functions of a compressor – Classification - Reciprocating compressor – Types - open type reciprocating compressor – Compression ratio, Clearance volume, Volumetric Efficiency-Definition only. Construction & working of single acting and single stage reciprocating compressor. Hermetically sealed compressors – construction and working - advantages over open type – Differences between open type and hermetically sealed type compressor. Semi sealed compressor. Rotary compressors – types, Roller type, Vane type, construction and working, advantages of rotary compressors. Centrifugal compressors – construction & working, advantages of centrifugal compressors. Screw compressors – construction and working - advantages. Scroll compressors – construction, working, advantages- variable frequency drive compressors - No problems and no derivations.	10
Unit II	**CONDENSERS**	

1221235312	**ELECTIVE -1 HVAC MACHINES**	L	T	P	C
THEORY		3	0	0	3

Condenser - Introduction – Functions – Working of condensers – Factors affecting condenser capacity – Material, Amount of contact and Temperature difference. Classification of condensers – Air cooled condenser, Water cooled condenser - Types of air-cooled condenser – Natural convection air cooled condenser, Forced convection air cooled condenser – Base mounted air-cooled condenser and Remote air-cooled condenser. Water cooled condenser – Waste water system and recirculated water system. Types of water-cooled condensers – Tube in tube condenser, Shell and coil condenser and Shell and tube condenser – Construction and working only. Comparison of air cooled and water-cooled condenser. Fouling factor - Evaporative condenser – Construction and working - No derivation - No problems.		8
Unit III	**EVAPORATORS**	
Evaporator - Introduction – Functions - Definition of capacity of evaporator – Factors affecting capacity of evaporator – Material, Temperature difference, Velocity of refrigerant, wall thickness, contact surface area. Types of evaporators – Bare tube coil evaporators, Finned evaporators, Plate evaporators, Shell and tube evaporators, Shell and coil evaporators, Double tube evaporators, flooded evaporators, Dry expansion evaporators, Natural convection evaporators, forced convection evaporators – Construction and working only. No derivation – No problems.		8
Unit IV	**EXPANSION DEVICES & COOLING TOWERS**	

1221235312	**ELECTIVE -1 HVAC MACHINES**	L	T	P	C
THEORY		3	0	0	3

4.1 Expansion devices- Introduction – Functions – Types of expansion devices – Capillary tube, Hand operated expansion valve, Automatic expansion valve, Thermostatic expansion valve, low side float valve, High side float valve – Construction and working only – No derivation – No problems. 4.2 Cooling tower - Introduction – Functions of a cooling tower – Basic principle involved in cooling of water, factors affecting rate of evaporation of water in a cooling	10
tower. Types of cooling towers – Natural draft cooling towers – Construction and working of Atmospheric natural draft (spray type) cooling tower and atmospheric natural draft (splash deck type) cooling tower. Mechanical draft cooling tower – Advantages and Disadvantages – Construction and working of forced draft cooling tower and induced draft cooling tower. Definition of Spray ponds - Definition of cooling tower range, approach and efficiency. No derivation – No problems.	
Unit V **FANS, BLOWERS & FILTERS**	
5.1 Fans & Blowers – Introduction - function of fans & blowers - Types of fans - centrifugal fans, three forms of blade or vane designs. Axial flow fan – Propeller fan, Tube axial fan and vane axial fan - Fan arrangements – fans in series, fans in parallel – Fan laws – Selection of fans. No derivation – No problems. 5.2 Filters – Introduction - Function of filters, impurities in air – dust, fumes, smoke, fogs, pollens, bacteria - Effects of dust on health. Methods of cleaning air – air filtration, air sterilization, air ionization, odour suppression. Air-filters – Dry filters, viscous filters, wet filters, electric filters, centrifugal dust collectors – No derivation – No problems.	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.**

1221235312	ELECTIVE -1 HVAC MACHINES	L	T	P	C
THEORY		3	0	0	3

Suggested list of Students Activity,

1. Prepare a list of different compressors in the laboratory with specification.
2. Presentation/Seminar by students on Condensers.
3. Presentation/Seminar by students on Evaporator.
4. Presentation/Seminar by students on cooling towers.

Reference Books:

1. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
2. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.
3. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
4. Refrigeration and Air – Conditioning by Khurmi and Gupta, S.Chand Publications.
5. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.

Web Reference

- https://youtu.be/IKn3c7Sup9k?si=eWDXDgmNGB-RnGs7
- https://youtu.be/PjcdqAkP0UA?si=Ik-us0HFvDgver4M
- https://youtu.be/QgVnRsdoxwQ?si=uf3JHI_hqwK2nkRR
- https://youtu.be/6YiCjnjLKH8?si=SSc125M7ZlDARi9t
- NPTEL

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

1221235312	**ELECTIVE -1 HVAC MACHINES**	L	T	P	C
THEORY		3	0	0	3

Four questions will be asked from every unit, students should write any two questions for 10 marks. The question may have two subdivisions only.

1221235313	ELECTIVE -1 CRYOGENIC ENGINEERING	L	T	P	C
THEORY		3	0	0	3

Introduction

Cryogenics engineering may be considered as the recent advancement in the field ofrefrigeration. The very low temperature below -150^0 C (120k) are considered as cryogenic temperature. Cryogenic temperatures are mostly used for liquefy the gases such as nitrogen and helium etc., The liquefaction process is to change the gases state into liquid state with aid of low temperature. The Cryogenic temperature is used to store the hydrogen, helium and nitrogen in liquid state. The Cryogenic fuels such as liquid hydrogen and liquid nitrogen are used in the rocket. In food preservation, liquid nitrogen is effectively used to freeze the food products to maintain the food quality and limit moisture loss for long period. The applications of cryogenic are tyre industry, medical field etc.,

Course Objectives

The objective of this course is to enable the student,

- Understand the requirements of Cryogenics
- Study about Cryogenics refrigeration systems
- Understand separation and purification of air process
- Study about the temperature and pressure measurement systems • Study the applications of Cryogenic systems

Course Outcomes

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

CO1: Explain the working of Cryogenics system and its applications

CO2: Acquire knowledge in the working of gas liquefaction system

CO3: Understand the gas separation process and gas purification process

CO4: Describe the working of cryogenic temperature measuring device

CO5: Explain the need of thermal insulation in cryogenic system and transportation of cryogenic fluids

Pre-requisites

Basic knowledge in Low Temperature Refrigeration.

CO/PO Mapping

1221235313	**ELECTIVE -1 CRYOGENIC ENGINEERING**	L	T	P	C
THEORY		3	0	0	3

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

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

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a 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.

1221235313	**ELECTIVE -1** **CRYOGENIC ENGINEERING**	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.

1221235313	ELECTIVE -1 CRYOGENIC ENGINEERING	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 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	**CRYOGENIC SYSTEM**	
Importance of Cryogenics – Applications areas of Cryogenics – expansion fitting, space research, Cryosurgery, semen preservation and Cryobiology – Hazards in Cryogenic Engineering - Cascade refrigeration system – Manufacture of solid carbon dioxide or Dry ice – Limitations of vapour compression refrigeration system for production of low temperature – Production of low temperature system – Philips refrigerator, Solvay refrigerator, Pulse tube refrigerator and Gifford refrigerator.		9
Unit II	**CRYOGENIC SYTEMS FOR GAS LIQUEFACTION**	
Cryogenic Liquefaction system – Linde system for liquefaction of air – Claude system for liquefaction of air –Liquefaction of Hydrogen - Liquefaction of helium – Simple Linde Hampson system for liquefaction for Nitrogen – Precooled Linde Hampson system for liquefaction of oxygen – Simple Claude system for liquefaction of Argon.		9
Unit III	**CRYOGENIC SYSTEM FOR SEPARATION OF GASES AND GAS PURIFICATION**	

1221235313	**ELECTIVE -1 CRYOGENIC ENGINEERING**	L	T	P	C
THEORY		3	0	0	3

Cryogenic system for separation of gases – Linde single column system for separation of oxygen – Linde double column system for separation of Nitrogen – Linde Bronn system for separation of hydrogen – separation of Neon and helium from air - separation of helium from natural gas – Gas purification process – Cryocondensation and Cryogenic gas adsorption.		9
Unit IV	**MEASUREMENT DEVICES FOR CRYOGENIC TEMPERATURE**	
Temperature measuring device – constant volume gas thermometer – platinum resistance thermometer – Pressure measuring device – McLeod gauge – thermocouple vacuum gauge – Liquid level measuring device – hydrostatic liquid level gauge – electric resistance gauge – Flow rate measuring device – venturi meter and turbine flow meter.		9
Unit V	**THERMAL INSULATION FOR CRYOGENIC SYSTEMS AND TRANSPORTATION OF CRYOGENIC FLUIDS**	
Thermal insulation for Cryogenic systems – vacuum insulation – porous and fibrous insulation – multi layer super insulation – micro sphere insulation- - Transportation of Cryogenic fluids – liquid nitrogen shielded Dewars – helium refrigerated storage vessel for transport – hydrogen refrigerated Dewar – transportation of liquid helium as high-pressure gas.		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,

1221235313	ELECTIVE -1 CRYOGENIC ENGINEERING	L	T	P	C
THEORY		3	0	0	3

1. Prepare a list of applications of cryogenic engineering.
2. Presentation/Seminar by students on liquefaction of gases.
3. Presentation/Seminar by students on separation of gases.
4. Presentation/Seminar by students on cryogenic system thermal insulation **Reference Books:**

1. Refrigeration & Air Conditioning – Domkundwar & Arrora Dhanpat Rai & Sons
2. PublicationsRefrigeration and Air-conditioning by Khurmi and Gupta, S. Chand Publications.
3. Fundamentals of Cryogenic Engineering by Mamata Mukhopadhyay – PHI Learning Pvt Ltd, New Delhi – 110001 - 2010
4. Cryogenic Engineering by Barrans. Tata Mc Graw Hill Publications

Web Reference

- https://www.youtube.com/watch?v=dbYrGxafciw
- https://www.youtube.com/watch?v=nDn7Cq_ZL1Y
- https://www.youtube.com/watch?v=68zcJBzut5s
- https://www.youtube.com/watch?v=UO-CZL4u9I4
- https://www.youtube.com/watch?v=q_hc4cSUMpg

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.

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	L	T	P	C
THEORY		3	0	0	3

Introduction

Application of refrigeration in food preservations and processing of food products is very much essential. Identification of food spoilage agents and control of food spoilage is of vital one. The content gives an idea about study of Packaging of food products, transportation and supply to the user end.

Course Objectives

The objective of this course is to enable the student,

- Understand the applications of refrigeration in food preservation
- Study about the application of refrigeration in food processing
- Study about the Processing and Preservation of Meat and Poultry products
- Study about the Processing and Preservation of Milk products, Beverages, Vegetables and Fruits
- Study about the Food Products Packaging, Refrigerated Transport for Foods

Course Outcomes

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

CO1: Explain the applications of refrigeration in food preservation

CO2: Explain the applications of refrigeration in food processing

CO3: Describe the Processing and Preservation of Meat and Poultry products

CO4: Describe the Processing and Preservation of Milk products, Beverages, Vegetables and Fruits

CO5: Explain about the Food Products Packaging, Refrigerated Transport for Foods

Pre-requisites

Basic knowledge in Refrigeration

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	L	T	P	C
THEORY		3	0	0	3

CO1	3	2	1	1	2	1	2
CO2	3	2	1	1	2	1	2
CO3	3	2	1	1	2	1	2
CO4	3	2	1	3	2	1	2
CO5	3	2	1	1	2	1	2

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

Instructional Strategy

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

Assessment Methodology

1221235314	**ELECTIVE -1** **FOOD PROCESSING AND PRESERVTION**	L	T	P	C
THEORY		3	0	0	3

	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.

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	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 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	**FOODS CONSTITUENTS AND FOOD QUALITY, FOOD PROCESSING OPERATIONS**	
	Foods Constituents and Food Quality– Carbohydrates – proteins – fats natural emulsifiers – organic acids – oxidants and antioxidants – enzymes – pigments and colours – flavours – vitamins and minerals – natural toxicants – water - definition of food quality, Quality factors in foods, indicators of food quality - importance and ways of food quality assessment Food Processing Operations– Materials handling – cleaning - separating - disintegrating – pumping – mixing – heating – cooling – evaporating – drying – forming – controlling – packaging – testing and measurement – quality control.	9
Unit II	**FOOD SPOILAGE FACTORS AND THEIR CONTROL, FOOD DEHYDRATION**	

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	L	T	P	C
THEORY		3	0	0	3

Food Spoilage Factors and Their Control– Introduction – causes of food spoilage – bacteria, yeasts and molds – natural food enzymes – heat and cold – moisture and dryness – air and oxygen – light – time – control of spoilage – various methods of preservation – heating, cooling, freezing, dehydrating, irradiating, smoking, adding chemicals etc. Food Dehydration– Reasons for drying – factors affecting dehydration	9

like surface area, temperature, air velocity, dryness of air, atmospheric pressure, evaporation etc. – drying curve – physical and chemical changes – drying methods – various types of driers – construction and working principle of driers.	

Unit III	**HEAT PROCESSING PRESERVATION, COLD PROCESSING PRESERVATION**	
Heat Processing Preservation – Sterilization – pasteurization – blanching – heat resistant of microorganisms – heating food in containers – still retort – agitating – pressure considerations – hydrostatic cooker and cooler – direct flame sterilization 9 – in-package pasteurization – heating food before packing – batch and HTST pasteurization – asceptive canning - hot pack and hot fill – flash18 process – microwave heating. Cold Processing Preservation – Refrigeration and freezing – refrigerated storage control of temperature, air circulation and humidity – storage requirements of perishable foods — freezing and frozen storage – characteristics of food being frozen – progressive freezing – methods of freezing – blast freezing – IQF – direct and indirect freezing – immersion freezing – freezing with cryogenic liquids		air

Unit IV	**PROCESSING AND PRESERVATION OF MEAT, POULTRY PRODUCTS, MILK PRODUCTS, BEVERAGES, VEGETABLES AND FRUITS**

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	L	T	P	C
THEORY		3	0	0	3

Processing And Preservation of Meat, Poultry Products – Meat products – grading – slaughtering practices – ageing, artificial tenderizing, smoking, cooking and curing of meat – meat colour changes – sausages and table ready meats – freezing of meat – poultry products – processing plant operations – tenderness and flavour - eggs – composition and spoilage factors. Processing and Preservation of Milk Products, Beverages, Vegetables and Fruits – Milk composition and grading – production practices – milk processing operations – types of milk – ice cream – composition and manufacturing procedure – cheese - types – cheddar cheese manufacture – beverages – classification and ingredients – manufacture of carbonated non-		9
alcoholic beverages – beer manufacture – wine manufacture – fermentation and other operations – coffee and tea processing and production practices – vegetables – properties and composition – post harvest practices – storage requirements of vegetables and fruits.		
Unit V	**FOOD PRODUCTS PACKAGING, REFRIGERATED TRANSPORT FOR FOODS**	
Food Products Packaging – Containers – functions and requirements – classification – packaging materials – properties and applications – primary, secondary and hermetic closure types of containers – metals, glass, papers, plastics and films, laminates and edible films – special features packages – boil in bag, fiber board or foil fibre board can, plastic shrink package, aerosol container etc. – other important considerations. Refrigerated Transport for Foods – Pre-cooling of foods – methods of pre-cooling – refrigerated trucks and trailers – rail road refrigerated cars – marine transport – air transport – methods of refrigeration – ice bunker refrigeration, mechanical refrigeration with conventional Freon refrigerants, liquid nitrogen refrigeration and other methods – transporting food with refrigerated containers		9

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	L	T	P	C
THEORY		3	0	0	3

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,

Prepare a list of storage temperature for different commodities.

Presentation/Seminar by students on food spoilage factor and control.

Presentation/Seminar by students on heat and cold processes preservation.

Presentation/Seminar by students on preservation of milk products.

Reference Books:

1. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.
2. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
3. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001.

Web Reference

- NPTEL
- NITTTR

1221235314	ELECTIVE -1 FOOD PROCESSING AND PRESERVTION	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.

1221235315	ELECTIVE -1 TRANSPORT AND SPECIAL APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

Introduction

Heating ventilation and air conditioning is a vast field with enormous applications. It is essential for every air conditioning technicians to know the various application of HVAC and some special applications of HVAC. This course is intended to provide an overall HVAC application in transport and some special area application. On completing this course, the learners will be able to know various application of HVAC in transport field and its special purpose application.

Course Objectives

The objective of this course is to enable the student,

- Understand the requirements of HVAC systems in transport area.
- Understand the concepts of car air conditioning systems
- Acquire knowledge in truck HVAC systems.
- Understand automatic climate control systems in automobiles.
- Learn the R&A/C special applications in manufacture of metals, heat treatment and special buildings

Course Outcomes

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

CO1: Explain the requirements/ components of transport HVAC systems

CO2: Demonstrate the concepts of car and truck ac systems

CO3: Describe the automatic climate control systems in automobiles

CO4: Demonstrate application of R&A/C in manufacture of metals and heat treatment CO5: Explain the application of R&A/C in special building.

Pre-requisites

Basic knowledge in Refrigeration and Air Conditioning

1221235315	ELECTIVE -1 TRANSPORT AND SPECIAL APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping

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

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

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.
- Throughout the course, a 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.

1221235315	**ELECTIVE -1** **TRANSPORT AND SPECIAL APPLICATION OF HVAC SYSTEM**	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology

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

1221235315	ELECTIVE -1 TRANSPORT AND SPECIAL APPLICATION OF HVAC SYSTEM	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 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	**TRANSPORT HVAC SYSTEM- PASSENGER CAR**	
Introduction – layout of car HVAC system – components – functions- necessityheating system layout -Working– circuits- cooling system layout –working – circuits – dashboard controls – for – heating – cooling – air distribution – layouts – modes – applications- Rear windshield defogger – fresh air supply – modes- location of filters- gas charging location – layout and procedure- troubles- causes – remedies-		9
Unit II	**TRANSPORT HVAC SYSTEM- COMMERCIAL GOODS TRUCK**	
Introduction - layout of commercial goods truck HVAC system – components – functions- necessity-heating system layout -Working– circuits- cooling system layout – working - circuits – dashboard controls – for – heating – cooling – air distribution – layouts – modes – applications – fresh air supply – modes- location of filters- gas charging location –layout and procedure- troubles- causes – remedies-		9
Unit III	**AUTOMATIC CLIMATE CONTROL SYSTEMS FOR TRANSPORT AIR CONDITIONING**	

1221235315	ELECTIVE -1 TRANSPORT AND SPECIAL APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

Introduction – necessity- comparison between manual and automatic climate control systems- overview of automatic climate control systems- components- functions- layouts- critical components- sensors-fuses-cutouts-relays-dashboard controls- switches – functions- working of automatic climate control system-fresh air supply- Advantages and disadvantages of automatic climate control systems- troubles – causes – remedies		9
Unit IV	**APPLICATION OF R&A/C IN MANUFACTURE AND HEAT TREATMENT OF METALS**	
Introduction – heat treatment – increased hardness, R&A/C application for cold treatment of metals – increased hardness, dimensional stability of tools and gauges, elimination of grinding cracks, increase of cutter tool life, high magnetic properties, workability, casting technology and fittings. Special industrial application – separation of liquefication of gases, oil refinery, rubber industries, printing industries and pharmaceutical industries. Medical applications – instruments, preservation of blood, tissues and virus, clinical application and medical hovercraft.		9
Unit V	**APPLICATION OF R&A/C IN CIVIL ENGINEERING**	
Introduction – application in heavy construction - concreate dams and concreate shell of nuclear reactor. Application in heavy foundation and tunneling. Environmental test equipments – strato-chambers and wind tunnels. Air-conditioning of special type buildings – air-conditioning of television center, air-conditioning for computer center, air-conditioning of automatic telephone exchange buildings and museum airconditioning. Ice rinks – application of R&A/C in ice skating and ice hockey – direct refrigeration recirculation system for ice rinks – size of the plant – indirect brine recirculation system for ice rinks		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.**

1221235315	ELECTIVE -1 TRANSPORT AND SPECIAL APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

Suggested list of Students Activity,

1. Prepare a list of components in bus air conditioning.
2. Presentation/Seminar by students on car a/c working.
3. Presentation/Seminar by students on air conditioning of commercial trucks.
4. Presentation/Seminar by students on application on HVAC in metal manufacturing.

Reference Books:

1. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
2. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
3. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001

Web Reference

- NPTEL
- NITTTR

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.

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

Introduction:

To impart knowledge about HVAC machines, handling the components and testing the performance is very much needed. This content would be useful to select the various types of components to be used in HVAC systems with different capacities. The knowledge about VFD compressor and capacity calculation of cooling coil is very essential in the present scenario.

Course Objectives:

The objective of this course is to enable the student to

- Practice, set and adjust the LP and HP cut-out, AEV, TEV and thermostat in refrigeration systems.
- Study the VFD compressor and its working.
- Test the capacitor and selector switch for its working.
- Test the pumping capacity of compressor.
- Determine the capacity of fan and evaporator coil of window airconditioner.
- Measure the dimensions of open type compressor and find its clearance factor.
- Determine the range, approach and efficiency of cooling tower.

Course Outcomes:

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

CO1: Set and adjust the LP and HP cut-out, AEV, TEV and thermostat in refrigeration systems.

CO2: Understand the working principle of VFD compressor.

CO3: Check the working condition of capacitor, selector switch and pumping capacity of compressor.

CO4: Calculate the capacity of fan and evaporator coil of window air conditioner.

CO5: Measure the dimensions of open type compressor and calculate the range, approach and efficiency of cooling tower.

Pre-requisites:

Basic knowledge of HVAC equipments

CO/PO Mapping

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

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

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

Instructional Strategy:

- 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 in a simulated environment, transitioning to real-world scenarios when possible

Assessment Methodology:

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

	Continuous Assessment (40 marks)				**End Semester Examination (60 marks)**
	CA1	**CA2**	**CA3**	**CA4**	
Mode	Practical Test	Practical Test	Practical Document	Practical Test	Practical Examination
Portion	50% Exercises	50% Exercises	All Exercises	All Exercises	All Exercises
Duration	2 Periods	2 Periods	Regularly	3 Hours	3 Hours
Exam Marks	50	50	100	100	100
Converted to	10	10	10	20	60
Marks	10		10	20	60
Tentative Schedule	7th Week	14th Week	15th Week	16th Week	

Note:

- **CA1 and CA2:** All the exercises/experiments as per the portions mentioned above should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation as 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.

1221235420	HVAC MACHINES PRACTICAL	L	T	P	C
PRACTICAL		0	0	4	2

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Procedure	15
B	Observation/Diagrams/Tabulation /Setting/Adjusting	30
C	Result	05
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 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.

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Procedure	20

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

B	Observation/Diagrams/Tabulation /Setting/Adjusting	60
C	Result	10
D	Viva-voce	10
TOTAL MARKS		**100**

Syllabus Contents

PRACTICAL		
Ex. No	Name of the Exercise	Hours
1	Setting and Adjusting of thermostat.	4
2	Setting and Adjusting of low pressure cut out in VCR system.	4
3	Setting and Adjusting of high pressure cut out in VCR system.	4
4	Setting and Adjusting of automatic expansion valve.	4
5	Setting and Adjusting of thermostatic expansion valve.	4
6	Study on compressor with (VFD) variable frequency driven motor.	4
7	Testing the pumping capacity of sealed compressor.	4
8	Testing and Replacement of faulty capacitor and selector switch.	4
9	Determination of capacity of fan.	4
10	Determination of capacity of evaporator coil of window air conditioner.	4
11	Measuring bore, stroke and clearance volume and calculating the clearance factor of an open type compressor.	4

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

12	Determination of range, approach and efficiency of cooling tower.	4
Practice + Continuous Test + Revision		12
TOTALHOURS		**60**

Suggested List of Students Activity:

1. Presentation / seminar by students on air conditioner with VFD compressor motor

Textbook for reference:

1. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
2. Refrigeration and Air – Conditioning by Khurmi and Gupta, S.Chand Publications.
3. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.
4. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
5. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001

Web-based/Online Resources:

- https://youtu.be/IKn3c7Sup9k?si=eWDXDgmNGB-RnGs7
- https://youtu.be/PjcdqAkP0UA?si=Ik-us0HFvDgver4M
- https://youtu.be/QgVnRsdoxwQ?si=uf3JHI_hqwK2nkRR
- https://youtu.be/6YiCjnjLKH8?si=SSc125M7ZlDARi9t

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

Sl.No	Equipments	Nos
01	VCR experimental setup with thermostat, LP HP cutouts, AEV and TEV	1
02	Sealed compressor and gauge manifold set	1
03	Experimental setup for testing capacitor and selector switch	1
04	Experimental setup for determining capacity of fan and anemometer	1
05	Window air conditioner experimental setup for finding the capacity of evaporator	1
06	Open type compressor	1
07	Cooling tower experimental setup	1

END SEMESTER EXAMINATION – PRACTICAL EXAM.

BOARD EXAMINATIONS

Note:

1221235420	**HVAC MACHINES PRACTICAL**	L	T	P	C
PRACTICAL		0	0	4	2

- 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 & Procedure	20
B	Observation/Diagrams/Tabulation /Setting/Adjusting	60
C	Result	10
D	Viva-voce	10
TOTAL MARKS		**100**

1221235541	**ELECTIVE 2** **HVAC MACHINE SERVICE PRACTICE**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

HVAC Machines service practice help to develop the technical hands-on skills required by the technicians working in various HVAC Engineering sectors. The topics covered are based on the syllabus for diploma studies in R&A/C Engineering. The course is planned to include basic practical experience in fault finding and servicing of refrigerator, window air conditioner, split air conditioner, air-cooled condenser, water-cooled condenser cooling tower, bottle cooler, water cooler, deep freezer and knowledge in servicing AHU.

Course Objectives:

The objective of this course is to enable the student to

- Test and service refrigerator.
- Identify the faults and service window air conditioner, split air conditioner and hermetic sealed compressor
- Find faults and service air cooled condenser and water-cooled condenser.
- Acquire knowledge of functioning of AEV and TEV.
- Understand the service and maintenance procedure of cooling tower, bottle cooler, water cooler, deep freezer and AHU.

Course Outcomes:

After successful completion of this course, the students can able to CO1: Illustrate the testing and service procedure of refrigerator.

CO2: Rectify faults in window air conditioner and split air conditioner.

CO3: Service water-cooled condenser and air-cooled condenser

CO4: Demonstrate the functions of AEV and TEV

CO5: Explain the service and maintenance procedure of cooling tower, bottle cooler, water cooler, deep freezer and AHU.

Pre-requisites:

Knowledge of refrigeration components in VCR system and cooling tower.

CO/PO Mapping

1221235541	ELECTIVE 2 HVAC MACHINE SERVICE PRACTICE	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

1221235541	**ELECTIVE 2** **HVAC MACHINE SERVICE PRACTICE**	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester**
	CA1	**CA2**	**CA3**	**CA4**	**Examination (60 marks)**
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	50% exercises	50% 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.

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

1221235541	ELECTIVE 2 HVAC MACHINE SERVICE PRACTICE	L	T	P	C
PRACTICUM		1	0	4	3

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 a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim & Procedure	10
B	Fault diagnosis /service /dismantling /assembling / maintenance procedure	35
C	Result	05
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.

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

1221235541	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**HVAC MACHINE SERVICE PRACTICE**	1	0	4	3

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

Part	**Description**	**Marks**
A	Aim & Procedure	15
B	Fault diagnosis /service /dismantling /assembling / maintenance procedure	40
C	Result	05
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

Syllabus Contents

Theory Portion		
Unit I	**Refrigerator And Window A/c service**	
Introduction – Components of Refrigerator and Window Air conditioner – Common faults and remedies in refrigerator and window air conditioner		3
Unit II	**Split Air Conditioner service**	

1221235541	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**HVAC MACHINE SERVICE PRACTICE**	1	0	4	3

Split Air conditioner – Components – Indoor unit, Outdoor unit – Available Capacities – Common faults and remedies of Split air conditioner – Service procedure.		3
Unit III	**Water cooled condenser, AEV and TEV Service**	
Water cooled condenser – Introduction – Causes and Failure – Faults diagnosis and remedies – service procedure. AEV – Functions – TEV – Functions.		3
Unit IV	**AHU and Cooling tower service**	
AHU – Introduction – Functions – Possible causes of failure – Faults diagnosis and Remedies – Service procedure – Cooling tower – Introduction – Types – Function – Service procedure.		3
Unit V	**Bottle cooler, Water cooler and Deep Freezer service**	
Fault diagnosis of BC, WC and DF – service procedure of Bottle cooler – Service procedure of water cooler - Service procedure of Deep freezer.		3

Practical Exercise

Ex. No	Name of the Exercise	Hours
1	Test and service the Refrigerator	4
2	Faults diagnosis and servicing of Window air conditioner	4
3	Faults diagnosis and servicing of Split air conditioner	4
4	Dismantling and assembling of window air conditioner.	4
5	Dismantling and assembling of split air conditioner.	4
6	Faults diagnosis and servicing of Water-cooled condenser	4
7	Faults diagnosis and servicing of Air-cooled condenser	4

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8	Servicing and maintenance procedure of Cooling tower	4
9	Servicing and maintenance procedure of Bottle cooler	4
10	Servicing and maintenance procedure of Water cooler	4
11	Servicing and maintenance procedure of Deep freezer	4
12	Servicing and maintenance procedure of AHU in Central plant	4
	Practice + Continuous Test + Revision	12
	TOTAL HOURS	**75**

Suggested List of Students Activity:

1.Prepare a preventive maintenance chart for split air conditioning

Text and Reference Books:

1. HVAC system design handbook – 5th edition by Roger W Haines PW and Michael E Myers P E LEED AP Mc Graw Hill Publications
2. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.

Web-based Online Resources:

- NPTEL
- NITTTR

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	Equipments	Nos

1221235541	**ELECTIVE 2** **HVAC MACHINE SERVICE PRACTICE**	L	T	P	C
PRACTICUM		1	0	4	3

01	Refrigerator	1
02	Window air conditioner	2
03	Split air conditioner	2
04	Water-cooled condenser	1
05	Air-cooled condenser	1
06	Cooling tower	1
07	Bottle cooler	1
08	Water cooler	1
09	Deep freezer	1

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

Practical document should be submitted for the examination with a bonafide certificate.

1221235541	**ELECTIVE 2** **HVAC MACHINE SERVICE PRACTICE**	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim & Procedure	15
B	Fault diagnosis /service /dismantling /assembling / maintenance procedure	40
C	Result	05
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

1020235542	Systems Applications and Product (SAP)	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

SAP stands for Systems, Applications, and Products. The practical use of SAP was first seen when data related to accounts and payroll was stored in an electrical device with specific programs to use the database logically and practically. ERP software is one of the most critical aspects of SAP software. To understand why the SAP Course is so important and popular, one needs to know about the areas where it works and the other aspects attached to SAP. Almost 80% of medium and small-sized organizations have joined the list of SAP services alongside large organizations.

Course Objectives:

After completing this subject, the student will be able to

- Equip with the skills and knowledge of SAP
- Develop and maintain SAP applications using various programming language.
- Understand the TDA/SAP process
- Understand the key steps in the TDA/SAP process.
- Be able to communicate the TDA/SAP process to others.

Course Outcomes

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

CO1: Understand the fundamental concepts of Enterprise Resource Planning (ERP) and SAP.

CO2: Establish a strong foundation in ABAP programming.

CO3: Develop skills in managing data structures using the ABAP Data Dictionary.

CO4: Introduce Object-Oriented ABAP concepts.

CO5: Master the creation of various types of ABAP reports.

Pre-requisites:

Knowledge of basics of Engineering and Industrial engineering

1020235542	Systems Applications and Product (SAP)	L	T	P	C
PRACTICUM		1	0	4	3

CO/PO Mapping

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

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

Instructional Strategy:

- The instructional strategy for teaching SAP 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.
- 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.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real-world scenarios when possible.
- Encourage Critical Analysis: Foster an environment where students can honestly assess experiment outcomes and analyze potential sources of error in case of discrepancies.

1020235542	Systems Applications and Product (SAP)	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Assessment Methodology:

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

1020235542	Systems Applications and Product (SAP)	L	T	P	C
PRACTICUM		1	0	4	3

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 documents. The Program, Procedure, Sketch and Output should be written by the student manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

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

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

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

1020235542	Systems Applications and Product (SAP)	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**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks
Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

●**CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

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

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

1020235542	Systems Applications and Product (SAP)	L	T	P	C
PRACTICUM		1	0	4	3

Syllabus Contents

Theory Portion- Unit I : SAP:	
Introduction–SAP - SAP r/3 architecture - central system – distributed presentation - 2-tier configuration - 3-tier configuration. System landscape and flow - single system landscape - two system landscape - three system landscape - multi system landscape. Installation of sap - installation concepts on windows & UNIX and quick sizing - naming convention, software kit, sap licensing - installation procedure – windows application server for unix sap system - r/3 directory structure, kernel gui administrator – optimization – security. Operation modes - manual switching of op modes - exceptional mode – monitoring.	8
Practical Exercises	
Exercise 1: Creating and Maintaining Master Records, Architecture - Logon and Password Security, Protecting Special Users	5
Exercise 2: Creating and Maintaining Single and Mass Users and User Groups - Copying, Deleting.	5
Exercise 3: Creating and Maintaining Single and Mass Users and User Groups Locking / Unlocking Users.	5
Exercise 4: Create/Maintaining Authorization/Profile Manually	5
Exercise 5: Create/Maintaining Roles/Generating Profiles by using PFCG.	5
Theory Portion - Unit II : SAP General Administration:	

1020235542	**Systems Applications and Product (SAP)**	L	T	P	C
PRACTICUM		1	0	4	3

General Administration – client administration - client maintenance - copying client within r/3 system (local). copying client between r/3 systems (remote) - export/import - protecting client. Monitoring and verifying a client copy - deleting client - tips and troubleshooting.General administration - transport management system - tms	7
terminology and concepts - configuring tms and checking transport directory - configuring transport domain, domain controller and group - configuring virtual sap system and displaying configuration - including sap systems in the transport domain - creating consolidation and delivery routes - maintaining sap systems without common transport directory - configuring external systems - locking and unlocking tms for a sap system - deleting sap system from the transport domain - deleting tms configuration. Change and Transport System - releasing and transporting change request and tasks - customizing, workbench, transport organizer - importing change requests. Spool Administration - print related terminology in os/sap level - setting local, remote and front-end printing - logical and real spool server - managing spool requests using output controller - connecting output devices to window system – saplpd, TemSE, Authorization.	
Practical Exercises	
Exercise 6: Creating Consolidation and Delivery Routes- Maintaining SAP Systems without Common Transport Directory - Configuring External System.	5
Exercise 7: Locking and Unlocking TMS for a SAP System.	5
Exercise 8: Deleting SAP System from the Transport Domain.	5
Exercise 9: Deleting TMS Configuration From the Transport Domain.	5
Exercise 10: Connecting Output Devices to Window System.	5
Assessment Test and Revision	10

1020235542	**Systems Applications and Product (SAP)**	L	T	P	C
PRACTICUM		1	0	4	3
Total					75

Text and Reference Books:

1. Sushil Markandeya , Kaushik Roy, SAP ABAP: Hands-On Test Projects with Business Scenarios, Apress, 2014.
2. Martin Murray, Jawad Akhtar, Materials Management with SAP ERP: Functionality and Technical Configuration, SAP Press, First Edition, 2016.
3. Sudipta Malakar, SAP/ ABAP/ HANA Programming, BPB Publication, 2018

Web Reference:

- https://www.youtube.com/watch?v=1jFQMadZLfs
- https://www.coursera.org/sap
- Free SAP Training | openSAP
- SAP Help Portal

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

Note:

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

SCHEME OF EVALUATION

1020235542	**Systems Applications and Product (SAP)**	L	T	P	C
PRACTICUM		1	0	4	3

Part	**Description**	**Marks**
A	Aim / Procedure	10
B	Steps / Execution	20
C	Report / Presentation	20
D	Result	10
E	Written Test (Theory Portions)	30
F	Viva Voce	10
TOTAL MARKS		100

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Industrial Internet of Things or IIoT refers to interconnected instruments, sensors and other devices which can be networked together in an industrial setting. This connectivity enables remote access, efficient monitoring, data acquisition and collection, analysis and exchange of different data sources and a lot more. IIoT solutions have enormous potential for increasing productivity, and are also known for their low cost and quick implementation.

Course Objectives:

The objective of this course is to enable the student to

- Understand the application of IIoT in automation of commercial and real world applications.
- Summarize the functions of various types of sensors.
- Understand the Designing Industrial IOT Systems for various applications.
- Facilitate the students to design simple IIoT concepts.

Course Outcomes:

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

CO1: Explain the basic computing features of the Arduino platform and programming.

CO2: Adapt to the Arduino platform and display their name in the LCD display. CO3: Perform LED blinking and LED pattern creation with push button control with Arduino.

CO4: Perform IR sensor interfacing, ultrasonic sensor interfacing and soil moisture interfacing with ESP32.

CO5: Design a system that integrates ultrasonic sensors for accurate distance measurement.

Pre-requisites:

Applied Physics

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

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

Instructional Strategy:

- It is advised that teachers take steps to increase the students' 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 measure student progress and provide targeted feedback.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester**

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

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

Note:

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

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

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

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

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

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

SCHEME OF EVALUATION

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

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

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

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

Question pattern – Written Test Theory

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

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

TOTAL	100 Marks

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

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

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

Syllabus Contents

Theory Portion	
UNIT I: INTRODUCTION TO INDUSTRIAL IOT (IIOT) SYSTEMS	**Period**

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, Support System for Industry 4.0, Smart Factories.		7
UNIT II: IMPLEMENTATION SYSTEMS FOR IIOT		
Sensors and Actuators for Industrial Processes, Sensor networks, Process 8 automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.		
Practical Exercises:		
1	To implement LED Blink and LED pattern with Arduino	5
2	Creating different LED patterns and controlling with push button switches.	5
3	Automated LED light control based on input from IR sensor and LDR	5
4	To display your name in a LCD 16 x2 display with Arduino.	5
5	Controlling servo motors with the help of joystick	5
6	Measurement of temperature and Pressure using ESP32	5
7	Calculate the distance to an object with the help of an Ultrasonic sensor and display it on a LCD	5
8	Design a system that integrates ultrasonic sensors for accurate distance measurement in the identified areas.	5
9	integrate sensors such as GPS, accelerometers, and panic Basic Burglar alert security system with the help of PIR sensor and Buzzer	5
10	Modules and sensor interfacing - Interfacing IR sensor and LED with ESP32	5
	Revision + Continuous Assessment	10
	Total Period	75

Suggested List of Students Activity:

1. Each students to write and submit the assignment on the topic ‘Contrast IT and OT’

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

2. Four students can be grouped as a batch and practice an additional experiment to interface any one of the Arduino compatible sensors with Arduino and observe the behaviour of sensors.
3. Introduction to Arduino platform and programming
4. Study on various sensors and actuators.

Text and Reference Books:

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

Web-based/Online Resources:

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

Equipment / Facilities required to conduct the Practical Course.

S.No	Name of the Equipment's	Quantity Required
1.	Arduino UNO set	15
2.	ESP32 set -Type C	15
3.	LED Bulb	15
4.	Resistor	15
5.	Push button	15
6.	Servo motor 5V DC	15
7	DC motor	15
8	5V DC Relay	15
9	Mini Breadboard	15
10	16 X 2 LCD Display with TTL	15
11	Gas sensor MQ2	15

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

12	IR Sensor	15
13	Temperature sensor DHT11 module	15
14	Ultrasonic sensor HC-SR04	15
15	Joystick module	15
16	Jumper wires - 3 nos.	As Required

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

Note:

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

SCHEME OF EVALUATION

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

1020235543	**Industrial IoT**	L	T	P	C
PRACTICUM		1	0	4	3

F	Viva Voce	10
	TOTAL	100

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

1221235544	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**COMPUTER INTEGRATED MANUFACTURING**	1	0	4	3

Introduction:

Computer Integrated Manufacturing (CIM) is the manufacturing approach of using computers to control the entire production process. This integration allows individual processes to exchange information with each part. Manufacturing can be faster and less error-prone by the integration of computers. Typically, CIM relies on closed-loop control processes based on real-time input from sensors. It is also known as flexible desi9gn and manufacturing.

Course Objectives:

The objective of this course is to enable the student to

- Understand the concepts and benefits of CIM in manufacturing Environments
- Utilize CAD/CAM software to design and stimulate manufacturing processes.
- Implement automation and robotics to optimize production efficiency and quality.
- Analyze real time data to make informed decisions and improve manufacturing operations.
- Explore emerging trends and technologies shaping the future of CIM

Course Outcomes:

After successful completion of this course, the students can able to CO 1: Understand the 2D&3D Transformation and Finite Element Analysis.

CO 2: Describe the Computer Aided manufacturing processes.

CO 3: Exploring the CNC programming and its functionalities.

CO 4: Understanding the concepts of 'Intellibotics'

CO 5: Exploring the future trends and Emerging technologies of CIM.

Pre-requisites:

Nil

CO/PO Mapping

1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

1221235544	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**COMPUTER INTEGRATED MANUFACTURING**	1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester**
	CA1	**CA2**	**CA3**	**CA4**	**Examination (60 marks)**
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	50% exercises	50% 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.

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

1221235544	ELECTIVE 2 COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
PRACTICUM		1	0	4	3

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 a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Creation of Sketch/Program writing	10
B	Modelling/Machining	30
C	Accuracy/Finishing	10
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.

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

●**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

1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3

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

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

Part	**Description**	**Marks**
A	Creation of Sketch/Program writing	15
B	Modelling/Machining	40
C	Accuracy/Finishing	05
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

Syllabus Contents

Theory Portion		
Unit I	**COMPUTER AIDED DESIGN AND FEA**	
Transformations: 2D & 3D transformations – translation, scaling, rotation and concatenation - Geometric modelling: Techniques - Wire frame modelling – Surface Modelling – Solid Modelling - Finite Element Analysis: Introduction – Basic steps – Advantages.		3
Unit II	**COMPUTER AIDED MANUFACTURING**	
Integrated CAD/CAM - Computer Assisted Process Planning (CAPP) – Types of CAPP Variant type, Generative type – advantages of CAPP - Just in Time manufacturing philosophy (JIT) - Introduction to Enterprise Resources Planning (ERP).		3
Unit III	**CNC PROGRAMMING**	

1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3

NC dimensioning – G codes and M codes – linear interpolation and circular interpolation - CNC program procedure - sub-program – canned cycles - stock removal - Rapid prototyping: Classification – subtractive – additive – advantages and applications		3
Unit IV	**ARTIFICIAL INTELLIGENCE AND ROBOTICS**	
Virtual machining – Introduction to Artificial Intelligence (AI) - Robotics: Definition – basic robot motion – robotic sensors – end effectors – mechanical grippers – vacuum grippers – Industrial applications of Robot – Material Transfer – Welding – Spray Coating – Assembly and Inspection.		3
Unit V	**FUTURE TRENDS AND EMERGING TECHNOLOGIES**	
Augmented Reality (AR) – Introduction - concept – Applications – Steps in Failure Modes and Effects Analysis (FMEA) – Product Development Cycle: Product Life Cycle - New product development processes.		3

Practical Exercise

Ex. No	Name of the Exercise	Hours
1	Draw the Front View / Sectional Front View (Full Section / Half Section) / Top View / Left Side View / Right Side View for the following given part drawing of the components in any CAD package. i) Sleeve and Cotter Joint	4
2	Draw the Front View / Sectional Front View (Full Section / Half Section) / Top View / Left Side View / Right Side View for the following given part drawing of the components in any CAD package. i) Protected Flange Coupling	4
3	Sketch the below 3D drawing with use of any CAD Packages. Bearing Block	4
4	Sketch the below 3D drawing with use of any CAD Packages. Screw Jack	4
5	Stimulate the program for CNC Turning Center	4
6	Stimulate the program for CNC Milling Center	4

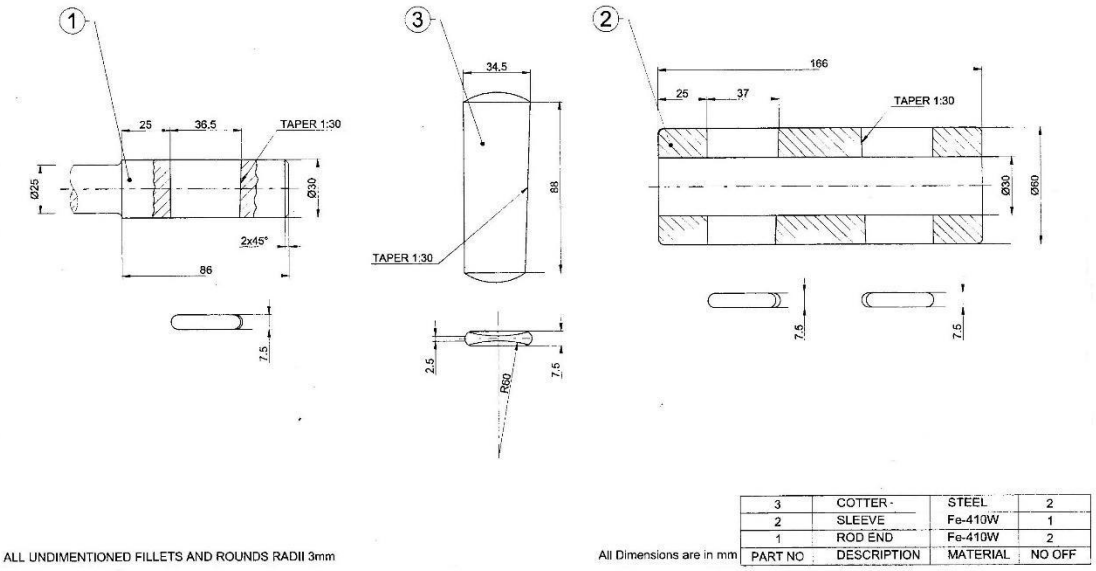
1221235544	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**COMPUTER INTEGRATED MANUFACTURING**	1	0	4	3

7	Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine.	4
8	Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.	4
9	Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.	4
10	Using subprogram - Create a part program and produce component in the Machine.	4
	Practice + Continuous Test + Revision	20
	TOTAL HOURS	**75**

1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3

Exercise No: 01

SLEEVE AND COTTER JOINT



ALL UNDIMENTIONED FILLETS AND ROUNDS RADII 3mm

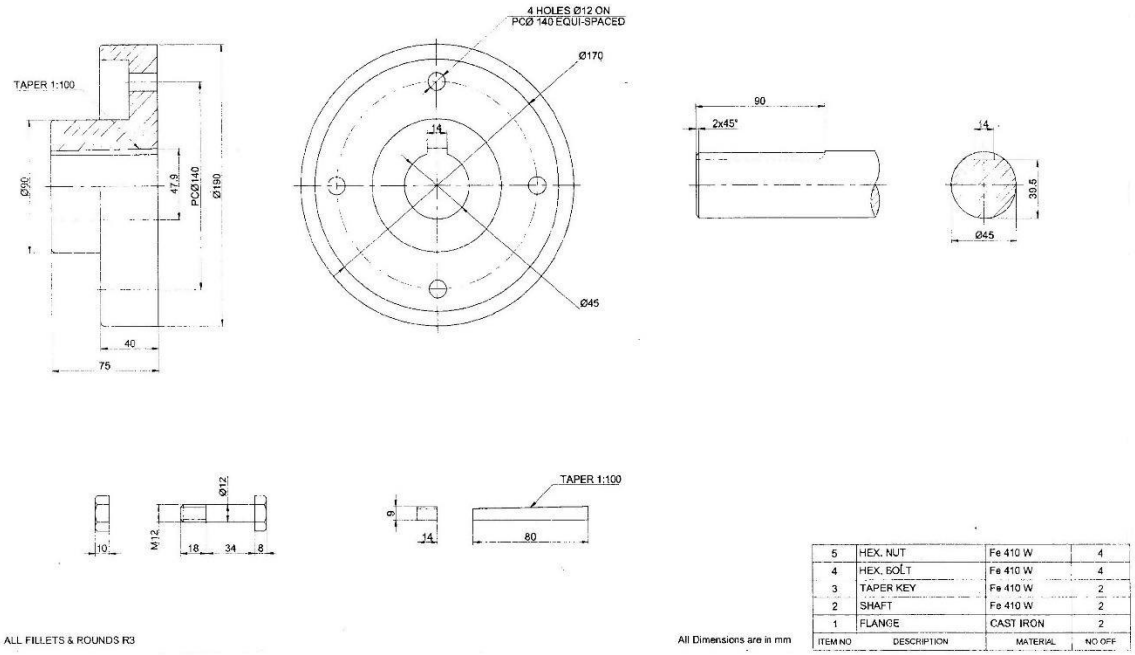
All Dimensions are in mm

PART NO	DESCRIPTION	MATERIAL	NO OFF
3	COTTER -	STEEL	2
2	SLEEVE	Fe-410W	1
1	ROD END	Fe-410W	2

1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3

Exercise No: 02

PROTECTED FLANGED COUPLING



ALL FILLETS & ROUNDS R3

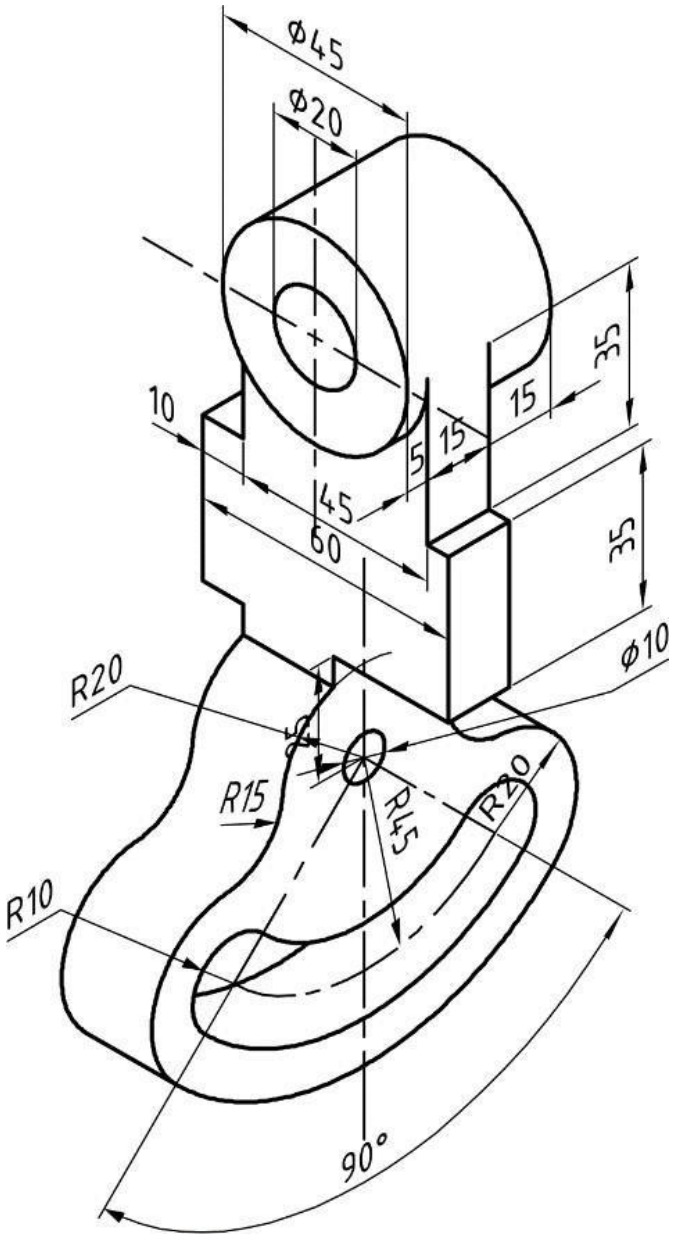
All Dimensions are in mm

ITEM NO	DESCRIPTION	MATERIAL	NO OFF
5	HEX. NUT	Fe 410 W	4
4	HEX. BOLT	Fe 410 W	4
3	TAPER KEY	Fe 410 W	2
2	SHAFT	Fe 410 W	2
1	FLANGE	CAST IRON	2

Exercise No: 03

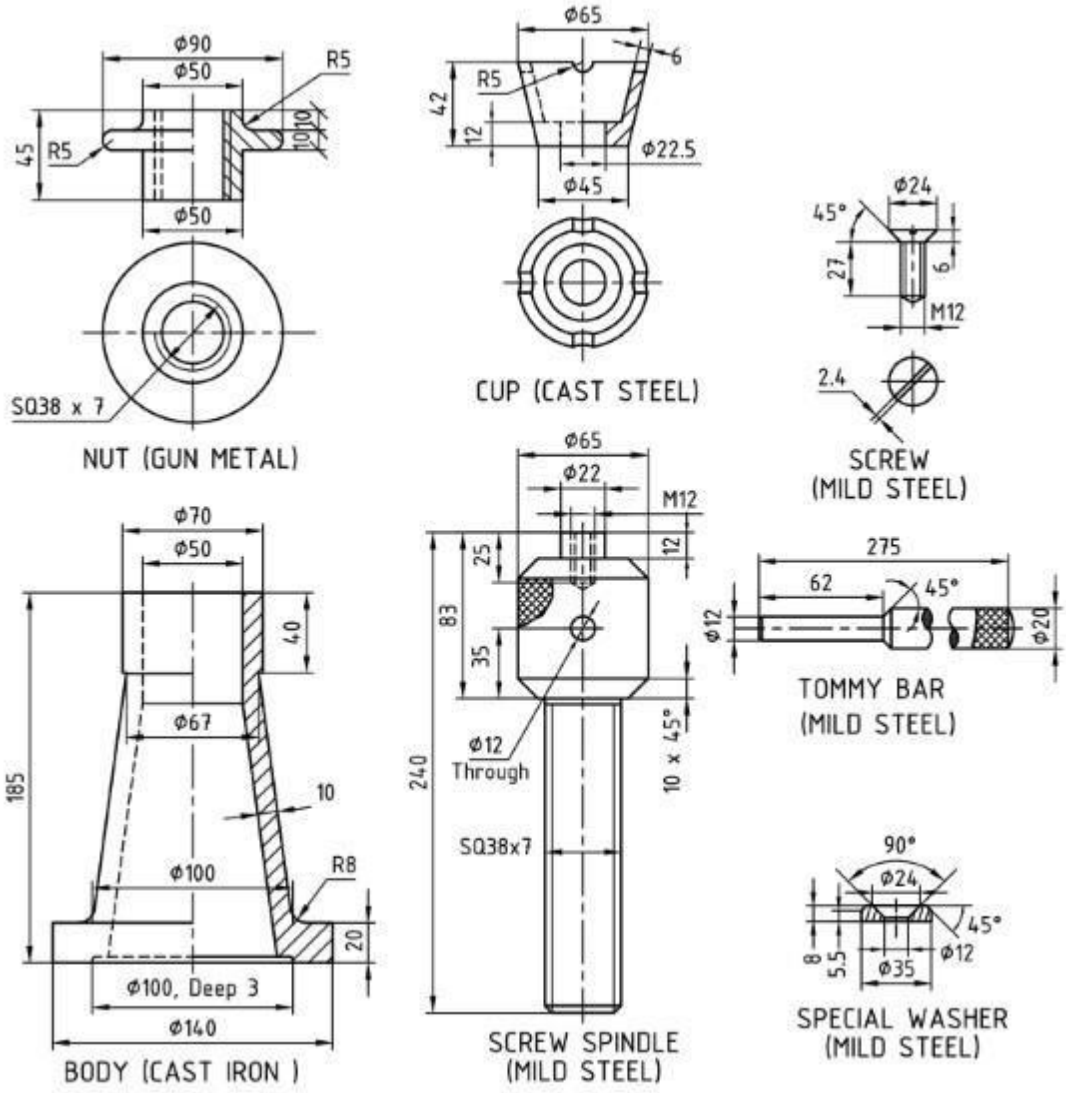
BEARING BLOCK

1221235544	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**COMPUTER INTEGRATED MANUFACTURING**	1	0	4	3



Exercise No: 04
Screw Jack

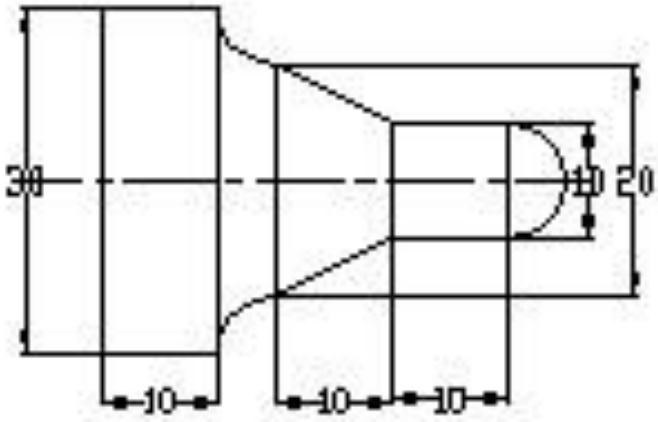
1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3



Exercise No: 05 (Stimulation only)

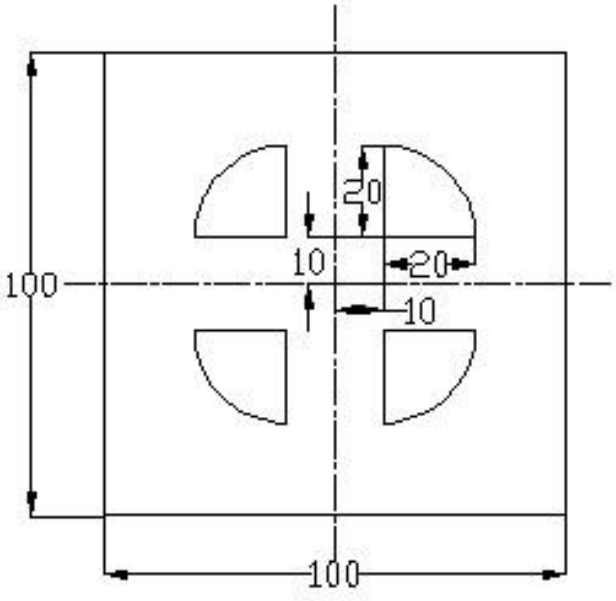
CNC Turning Center:

1221235544	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**COMPUTER INTEGRATED MANUFACTURING**	1	0	4	3



Exercise No: 06 (Stimulation only)

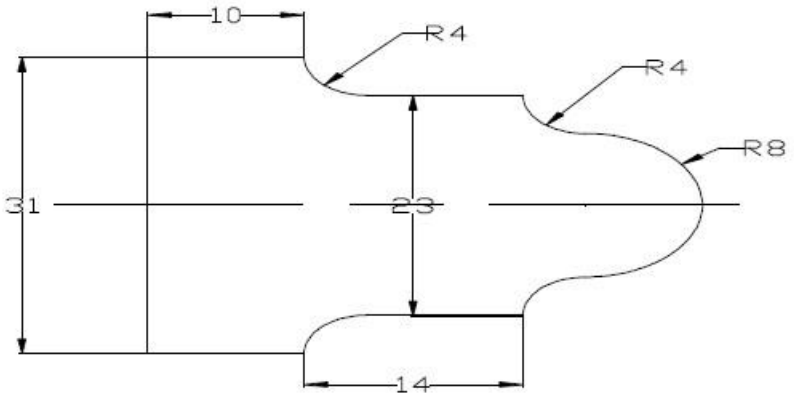
CNC Milling Center



Exercise No : 07

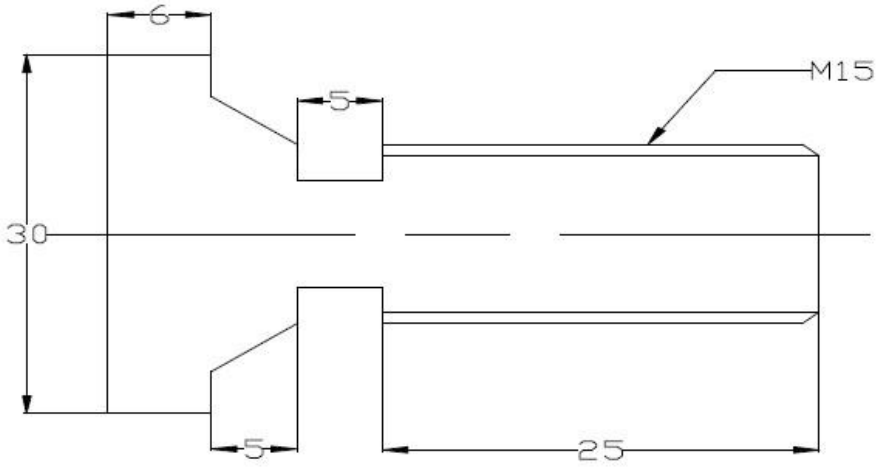
1221235544	ELECTIVE 2 COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
PRACTICUM		1	0	4	3

Using Stock removal cycle – Create a part program for multiple turning operations and produce component in the Machine.



Exercise No: 08

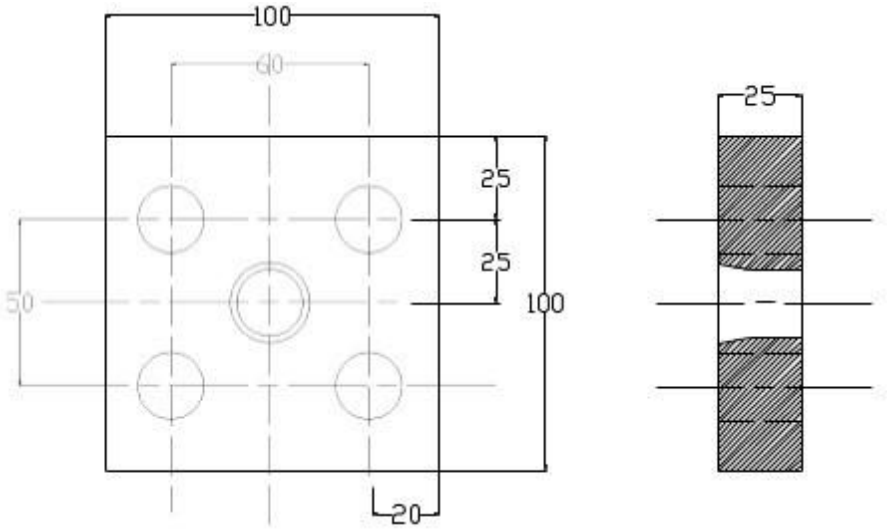
Using canned cycle - Create a part program for thread cutting, grooving and produce component in the Machine.



Exercise No: 09

1221235544	ELECTIVE 2 COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
PRACTICUM		1	0	4	3

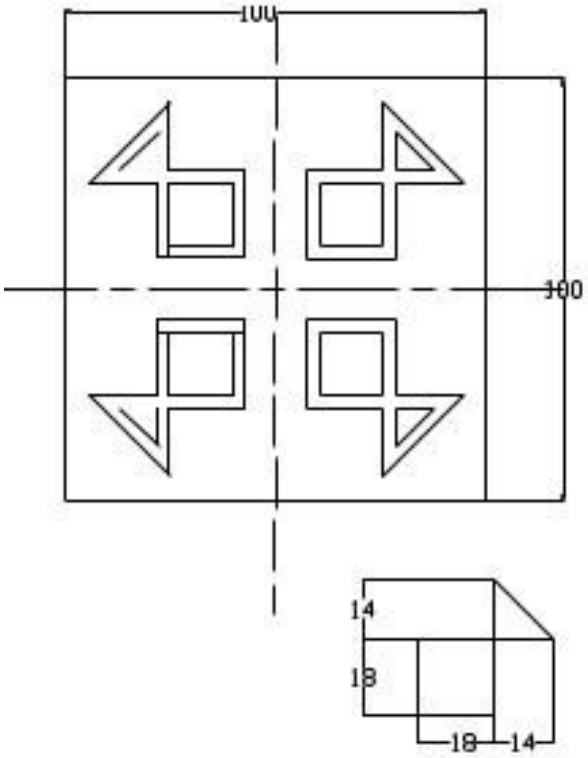
Using canned cycle - Create a part program for drilling, tapping, counter sinking and produce component in the Machine.



Exercise No: 10

1221235544	ELECTIVE 2 COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
PRACTICUM		1	0	4	3

Using subprogram - Create a part program and produce component in the Machine



Suggested List of Students Activity:

1.Students shall draw 2D & 3D drawings with any CAD Packages

Text and Reference Books:

1. Dr.P.N.Rao, “CAD/CAM Principles and Applications,”, Tata Mc Graw Hill
2. Publishing Company Ltd.
3. Dr.Sadhu Singh, “Computer Aided Design and Manufacturing,”, Khanna Publishers, NewDelhi, Second Edition,2000.
4. R.Radhakrishnan, and S.Subramanian, “CAD/CAM/CIM”, New Age International Pvt. Ltd.

Web-based Online Resources:

1221235544	ELECTIVE 2	L	T	P	C
PRACTICUM	COMPUTER INTEGRATED MANUFACTURING	1	0	4	3

- https://youtu.be/49RET0NITY?si=upytpQ0QnM3hSWM4
- https://youtu.be/_xBO7SLYMOs?si=xnCUX1t9ct_akLvv

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	Equipments	Nos
01	Personal computer	30
02	3D Solid Modelling and Simulation software	Sufficient to Strength
03	Required Software's: CAD Package	Sufficient to Strength
04	CNC Lathe	02
05	CNC Mill	02
06	Laser / Inkjet Printer	01
07	Consumables	Sufficient to Strength

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

1221235544	**ELECTIVE 2**	L	T	P	C
PRACTICUM	**COMPUTER INTEGRATED MANUFACTURING**	1	0	4	3

Practical document should be submitted for the examination with a bonafide certificate.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Creation of Sketch/Program writing	15
B	Modelling/Machining	40
C	Accuracy/Finishing	05
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

1020235545	**Industrial Robotics**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction

It has been realized that rapid industrialization and globalization needs industries to be more competitive and deliver cost effective quality products. This needs industries to implement flexible manufacturing systems where Robotic technology plays a major role. Hence study of robotic technology is very essential, To acquire knowledge about the hydraulic and pneumatic systems and its functions of the components. Understand the control methods of automation.

Course Objectives

The objective of this course is to prepare the student,

- To understand the basics of robot components and process automation.
- To execute the Robot programming using simulation software.
- To execute the Robot programming and Execute.
- To perform the basics of robotics and simulation of software fixtures for material handling and industrial applications.
- To execute program for various applications in manufacturing by using robot programming and industrial safety systems.
- To learn about the software and hardware systems for industrial Robotics

Course Outcomes

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

CO1: Describe the components of Robot and its joints & links in Robot configuration,

CO2: Classify the robot controller Drives and grippers,

CO3: Explain industrial applications of robot in Manufacturing environment

CO4: Generate robot program for material handling applications

CO5: Execute / Simulate programs for various applications in manufacturing by using robot programming.

1020235545	**Industrial Robotics**	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites

Knowledge of Basic Robot Engineering, Robot software, Robot programming .

CO/PO Mapping

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

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

Instructional Strategy

Active Learning: Activities for active learning can include think-pair-share strategies as well as kin-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 encourage the students to implement the techniques in their own place / Lab through the Industry-Institute interactions.

1020235545	**Industrial Robotics**	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

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

Note:

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

  Practical documents should be maintained for every experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should

be evaluated for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

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

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

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Step / Procedure	10
B	Write Program	20
C	Edit Program / Simulate / Execution	20
TOTAL		50
D	Practical Documents (As per the portions)	10
		60

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

Cycle - II **Exercise 6, 7, 8, 9, 10 and 11.**

- **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.

1020235545	**Industrial Robotics**	L	T	P	C
PRACTICUM		1	0	4	3

Question pattern – Written Test Theory

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

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION Model Practical Examination - Practical Exam

PART	**DESCRIPTION**	**MARKS**
A	Step / Procedure	10
B	Write Program	20
C	Edit Program / Simulate / Execution	20
D	Result / Finish / Accuracy	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.

1020235545	**Industrial Robotics**	L	T	P	C
PRACTICUM		1	0	4	3

Syllabus contents

THEORY	
Introduction – Definitions of Robot -Robot Anatomy – Basic configuration of Robotics – Robot Components – Manipulator, End effecter, Driving system, Controller and Sensors. Mechanical arm – Degrees of freedom – Links and joints – Types of joints – Joint notation scheme – Pitch, Yaw, Roll – Classification of robots – Work envelope, Work Volume. Robot controller – Configuration - Four types of controls – Open loop and closed loop controls – Speed of response and stability – Precision of movements: Spatial resolutions, accuracy and repeatability. Pneumatic drives – Hydraulic drives – Mechanical drives – Electrical drives –Stepper motors, DC Servo motors and AC Servo motors – Salient features – Applications and Comparisons of Drives. End effecters –Grippers – Mechanical Grippers, Magnetic Grippers, Vacuum Grippers, Two fingered and Three fingered Grippers, Internal and External Grippers, – End Of Arm Tooling (EOAT)- Selection and Design considerations Robot applications – Material handling – Press loading and unloading –Die casting – Machine tool loading and unloading – Spot welding – Arc welding – Spray painting – Assembling – Finishing – Automatic Guided Vehicle – Adopting robots to workstations – Requisite robot characteristics and Non requisite robot characteristics – Stages in selecting robots for industrial applications – Safety considerations for robot operations – Robotics in the future and characteristics task–Economical analysis of robots – Social implications.	15
Practice	6

1020235545	**Industrial Robotics**	L	T	P	C
PRACTICUM		1	0	4	3

Study of Robot system, Study and practice in the robot simulation software .	

Practical Exercise

Ex.No	Name of the Experiment	
1.	Programming using Position recording using Cartesian co-ordinate system - (No. of positions – 9).	4
2.	Programming using Position recording using Polar co-ordinate system - (No. of positions - 9).	4
3.	Programming using Loops and sub – routine.	4
4.	Pick and place of objects (No. of objects to be specified- 6).	4
5.	Pick and stack of objects (No. of objects to be specified- 6).	4
6.	Arc welding practice(Length. of weld to be specified).	4
7.	Programming using Spot welding practice - (No. of spots Minimum 3).	4
8.	Assembling practice (Simple assembling).	4
9.	Profile cutting practice (combination of lines and arcs).	4
10.	Programming for Spray painting practice - (Area - 300mm x 300mm).	4
11.	Programming using Machine loading and unloading practice with time delay.	4
Revision + Assessment		10
Total		75

Textbook:

1. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey, and Ashish Dutta, Industrial Robotics – Technology, Programming and Applications, 2nd Edition, McGraw Hill, 2013.
2. Appuu Kuttan, Robotics, I.K. International Publishing House Pvt. Limited, 2013

1020235545	Industrial Robotics	L	T	P	C
PRACTICUM		1	0	4	3

3. Ganesh S. Hegde, A Textbook of Industrial Robotics, Second Edition, Laxmi Publications (P) Ltd., 2015
4. Nagarajan Ramachandran, Introduction to Industrial Robotics, Pearson India Education Services Pvt. Ltd., 2016

Website links for reference:

- https://www.youtube.com/playlist?list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH
- https://www.youtube.com/playlist?list=PLFW6lRTa1g81AGUOky_xVhNVsudGwZxsY

LIST OF EQUIPMENTS

1. Robot simulation software or Robotic arm
2. Computer - 30 Nos.

1020235545	Industrial Robotics	L	T	P	C
PRACTICUM		1	0	4	3

END SEMESTER EXAMINATIONS – PRACTICAL EXAM

Note:

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Step / Procedure	10
B	Write Program	20
C	Edit Program / Simulate / Execution	20
D	Result / Finish / Accuracy	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.

1020235654	**Innovation & Startup**	L	T	P	C
PRACTICUM		1	0	2	2

Introduction

The integration of Innovation and Start-ups concept within the syllabus is testament to the forward thinking nature of educational institutions. By introducing this concept, students are provided with a solid foundation upon which they can build their skills in Innovation and Start-ups. This course can bridge the gap between theory and practice. It allows students to apply the knowledge they have acquired in a real world context, thereby enhancing their understanding and retention of the above concept. This experimental learning approach not only fosters a deeper level of engagement but also trains student with practical skills necessary to navigate the complexities of the business world. This also empowers students to become an Innovator or Entrepreneur. With necessary tools and knowledge, educational institutions are preparing the next generation of entrepreneurs to tackle the challenges and opportunities that lie ahead. This syllabus will explore the different facets of innovation, including its importance, types and strategies for fostering a culture of innovation within organizations

Course Objectives

The objective of this course is to enable the students oTo understand

the concept of Innovation and Start-ups.

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

1020235654	**Innovation & Startup**	L	T	P	C
PRACTICUM		1	0	2	2

Course Outcomes

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

CO 1: Differentiate between Innovation and Start-ups

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

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

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

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

Pre-requisites:

There are no specific prerequisites for this course, although a basic understanding of business and technology concepts would be beneficial.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7

1020235654	**Innovation & Startup**				L	T	P	C
PRACTICUM					1	0	2	2

CO1	-	-	1	-	2	3	3
CO2	-	-	1	-	2	3	3
CO3	-	-	1	-	2	3	3
CO4	-	-	1	-	2	3	3
CO5	-	-	1	-	2	3	3

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

1020235654	**Innovation & Startup**	L	T	P	C
PRACTICUM		1	0	2	2

Assessment Methodology

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

Continuous Assessment - 40 marks

S. No	**Description**	**Marks**
CA 1	**Class Assessment (50 marks) - Unit – I,II & III** Written Examination - Theory Questions 10 questions out of 15 questions (10 x 3 marks :30 marks) 4 questions out of 6 questions (4 x 5 marks : 20 marks)	10 marks
CA 2	**Seminar Presentations (20 marks- each topic carries 10 marks) - Unit IV** Students should present any two topics with PPTs	10 marks
CA 3	Submission of Industry Visit Project Report - **(30 marks) - Unit V**	20 marks

1020235654	**Innovation & Startup**	L	T	P	C
PRACTICUM		1	0	2	2
		Total		**40 marks**	

Syllabus Contents

UNIT I	**INTRODUCTION TO INNOVATION**	
An Introduction to Innovation and Creativity- Innovation in current Environment - 6 Types of Innovation - Challenges of Innovation - Steps of Innovation Management - Divergent v/s Convergent thinking - Design thinking and Entrepreneurship.		
UNIT II	**INCUBATION CLUBS, IPR, PATENTS AND COPYRIGHTS**	
Idea Generation - Incubation Clubs - Prototype Development - Marketing of Innovation - Management of Innovation - Creation of IPR -Types of IPR - Patents and Copyrights - Patents in India - Technological and Non-Technological Innovation Process.		6
UNIT III	**GOVERNMENT AND NON-GOVERNMENT FUNDING SCHEMES FOR START-UPS**	
An introduction to Start-up - Start-ups in India - Procedure for registration of Start-ups - Business Model- Business Plan - Case Studies - Opportunities and Challenges - Funding supports from Government Schemes -MUDRA, TANSEED, NEEDS, PMEGP, UYEGP – Non-Government Schemes - CSR Fund - Angel Investors - Venture Capitalist.		6
UNIT IV		

1020235654	**Innovation & Startup**	L	T	P	C
PRACTICUM		1	0	2	2

All the students have to select a minimum of 2 topics from the list given below. They are expected to collect the resources with the help of faculty assigned to them to prepare PPTs for presentation 1. Idea Generation. 2. Innovation Management. 3. Product Development.	9
4. Business Model Innovation. 5. Organizational Culture and Change Management. 6. Leadership and Innovation. 7. Barriers to Innovation. 8. Innovation Marketing. 9. E-Commerce success stories (any one). 10. Role of Start-ups in Higher Education. 11. Professional Networking in Building Brands. 12. How to start a start-up in India.	
UNIT V **EXPOSURE TO INDUSTRY**	
All the students should visit and study the nearby industries, incubation centres, startups etc., and select any one to prepare a project report which covers the Name of the Industry/Organization, Introduction of the Industry, Type of the Industry, Scope of the Industry, Plant Layout and Location, Details of Plant and Machineries, Process flow chart, Manufacturing Methods, Process of Manufacturing, Product Manufacturing, Quality Control, Marketing, Product selling - Conclusion.	**18**
Total	**45**

1020235654	**Innovation & Startup**	L	T	P	C
PRACTICUM		1	0	2	2

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations.

Detailed Allocation of Marks

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

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

Introduction

Industrial training is a crucial component of the diploma engineering curriculum, designed to bridge the gap between theoretical knowledge and practical application. Typically conducted during vacation periods, this two-week training program provides students with hands-on experience in their respective engineering fields. The primary objectives are to enhance practical skills, familiarize students with industry standards, and prepare them for future employment. Two-week industrial training during vacation periods is an invaluable part of diploma engineering education. It not only equips students with practical skills but also provides a comprehensive understanding of the industry, preparing them for successful engineering careers.

Objectives

1. Practical Exposure: Students gain direct exposure to real-world engineering practices, tools, and technologies.
2. Skill Enhancement: The training helps in developing technical and soft skills that are essential for professional growth.
3. Industry Insight: Students learn about the working environment, operational procedures, and challenges faced by industries.
4. Professional Networking: The training offers opportunities to interact with industry professionals, which can be beneficial for career prospects.
5. Application of Knowledge: It allows students to apply classroom knowledge to solve practical problems, enhancing their understanding and retention of engineering concepts.

Structure of the Training Program

- Orientation: Introduction to the company, its operations, and safety protocols.
- Project Assignment: Students are assigned specific projects or tasks relevant to their field of study.
- Supervision and Mentorship: Industry professionals guide and mentor students throughout the training.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

- Skill Development Workshops: Sessions on technical skills, software tools, and industry best practices.
- Assessment and Feedback: Performance evaluations and constructive feedback to help students improve.

Benefits for Students

- Enhanced Employability: Practical experience makes students more attractive to potential employers.
- Confidence Building: Working in a real-world setting boosts confidence and professional demeanor.
- Clarified Career Goals: Exposure to various roles and responsibilities helps students define their career paths.

Course Outcomes

CO 1: Demonstrate proficiency in using industrial machinery, tools, and software. CO 2: Able to identify, analyze, and solve engineering problems using industry-standard methods and practices.

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

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

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

Duties Responsibilities of the Faculty Mentor.

One faculty mentor should be assigned for every 30 students by the HOD / Principal. Faculty mentors shall play a crucial role in overseeing and guiding students during their industrial training program in Diploma engineering.

Pre-Training Responsibilities:

1. Orientation and Preparation:
    - Conduct orientation sessions to familiarize students with the objectives, expectations, and guidelines of the industrial training program.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

○Assist students in understanding the importance of industrial training in their academic and professional development.

2. Placement Coordination:
    - Collaborate with the placement cell or industry liaison office to secure suitable training placements for students that align with their academic specialization and career interests.
    - ○Facilitate communication between the institution and host organizations to ensure smooth coordination of training arrangements.
3. Training Plan Development:
    - Help students develop a detailed training plan outlining learning objectives, tasks, and expected outcomes for the training period.
    - ○Guide students in setting SMART (Specific, Measurable, Achievable, Relevant, Time-bound) goals for their training experience.

During Training Responsibilities:

4. Monitoring and Support:
    - Regularly monitor the progress of students during their industrial training. Maintain communication with both students and industry supervisors to track performance and address any issues that may arise.
    - ○Provide ongoing support and guidance to students, offering advice on technical challenges, professional conduct, and workplace etiquette.
5. Technical Guidance:
    - Offer technical guidance and mentorship related to the specific engineering discipline or specialization of the students. Help them apply theoretical knowledge to practical situations encountered in the industry.
6. Problem-Solving Assistance:
    - Assist students in overcoming obstacles or challenges encountered during their training. Encourage them to develop problem-solving skills and resilience in realworld engineering scenarios.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

7. Feedback and Evaluation:
    - Provide constructive feedback on students' performance based on reports, assessments, and observations gathered from industry supervisors.
    - Evaluate students' achievements in relation to their training objectives and competencies developed during the program.

Post-Training Responsibilities:

8. Reflection and Debriefing:
    - Conduct debriefing sessions with students to reflect on their training experiences, discuss lessons learned, and identify areas for further improvement.
    - Help students articulate their learning outcomes and how these experiences contribute to their professional growth.
9. Documentation and Reporting:
    - Ensure comprehensive documentation of students' training activities, achievements, and feedback received from industry supervisors.
    - Prepare reports summarizing students' performance and submit these to relevant departments or committees for review and assessment.
10. Career Counseling:
    - Provide career guidance and counseling to students based on their industrial training experiences. Assist them in leveraging these experiences for future job applications or further academic pursuits.
11. Continuous Improvement:
    - Collaborate with industry partners to continuously improve the quality and relevance of the industrial training program.
    - Incorporate feedback from students and industry supervisors to enhance the effectiveness of future training placements.

By fulfilling these duties and responsibilities, faculty mentors contribute significantly to the overall educational experience and professional development of Diploma engineering students during their industrial training program.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

Instructions to the students Before

Starting Industrial Training:

1. **Orientation and Preparation:**
    - Attend orientation sessions conducted by the institution or faculty mentors to understand the objectives, expectations, and guidelines of the industrial training program.
    - Familiarize yourself with the specific policies, procedures, and safety regulations of the host organization where you will be undergoing training.
2. Setting Goals:
    - Set clear and specific goals for your industrial training period. Define what skills, knowledge, and experiences you aim to gain during this time.
    - Discuss your goals with your faculty mentor and seek their guidance in developing a training plan that aligns with your career aspirations.
3. Professional Attire and Conduct:
    - Dress appropriately and professionally according to the standards of the industry and host organization.
    - Maintain a positive attitude, demonstrate punctuality, and adhere to workplace etiquette and norms.

During Industrial Training:

4. Learning and Engagement:
    - Actively engage in all assigned tasks and projects. Seek opportunities to learn new skills and technologies relevant to your field of study.
    - Take initiative in asking questions, seeking clarification, and participating in discussions with supervisors and colleagues.
5. Adaptability and Flexibility:
    - Adapt to the work environment and demonstrate flexibility in handling various responsibilities and challenges that arise during your training.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

○Be open to different roles and tasks assigned to you, as this will broaden your experience and skill set.

6. Professionalism and Communication:
    - Communicate effectively with supervisors, colleagues, and clients as required. Practice clear and concise verbal and written communication.
    - ○Demonstrate professionalism in all interactions, respecting confidentiality, and adhering to company policies and procedures.
7. Safety and Compliance:
    - Prioritize safety at all times. Familiarize yourself with safety protocols, procedures, and emergency exits in the workplace.
    - ○Follow all safety guidelines and regulations to ensure your well-being and that of others around you.

After Completing Industrial Training:

8. Reflection and Documentation:
    - Reflect on your training experience. Evaluate what you have learned, the challenges you faced, and how you have grown professionally.
    - ○Maintain a journal or log documenting your daily activities, achievements, and lessons learned during the training period.
9. Feedback and Evaluation:
    - Seek feedback from your industry supervisor and faculty mentor on your performance and areas for improvement.
    - ○Use constructive feedback to enhance your skills and competencies for future career opportunities.
10. Career Planning:
    - Use your industrial training experience to inform your career planning and decision-making process.
    - ○Discuss your career goals and aspirations with your faculty mentor or career counselor for guidance on next steps after completing your diploma.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

By following these instructions, Diploma engineering students can make the most of their industrial training experience, gain valuable insights into their chosen field, and prepare themselves effectively for future professional endeavors.

Attendance Certification

Every student has to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution faculty mentor.

Training Reports

The students have to prepare reports: The report in the form of a diary to be submitted to the concerned faculty mentor of the institution. This will be reviewed while awarding Internal assessment.

Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

In addition to the diary, students are required to submit a comprehensive report on training with details of the organisation where the training was undergone after attestation by the supervisors. The comprehensive report should incorporate study of plant / product / process / construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training. Any data, drawings etc. should be incorporated with the consent of the Organisation.

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

Scheme of Evaluation

Internal Assessment

Students should be assessed for 40 Marks by industry supervisor and polytechnic faculty mentor for the Internal Assessment.

Sl. No.	Description	Marks
A	Punctuality and regularity. (Attendance)	10
B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Self expression / communication skills. Interpersonal skills / Human Relation.	10
D	Report and Presentation.	10
	Total	40

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of industrial training. The marks scored will be converted to 60 marks for the End Semester Examination.

Scheme of Evaluation

Sl. No.	Description	Marks
A	Daily Activity Report and Attendance certificate.	20
B	Comprehensive report on Internship, Relevant Internship Certificate from the concerned department.	30

1020235773	**Industrial Training**	Summer Vacation	C
Internship			2

C	Presentation by the student at the end of the Internship.	30
D	Viva Voce	20
Total		100

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

Introduction

Mathematics is essential for engineering students to understand core engineering subjects. It provides the framework for engineers to solve problems in engineering domains. This course is designed to bridge the gap between diploma mathematics and B.E/B.Tech mathematics in matrix algebra, differential calculus, vector calculus, differential equations, and Laplace transforms.

Course Objectives

The objective of this course is to enable the students to

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

Course Outcomes

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

CO1: Find eigenvalues and corresponding eigenvectors of a square matrix.

CO2: Apply the knowledge of partial differentiation to evaluate Jacobian and extremities of two variable functions.

CO3: Evaluate the gradient of a scalar field and the divergence and curl of vector fields.

CO4: Solve ordinary differential equations using various techniques.

CO5: Use Laplace transforms to solve first-order ordinary differential equations.

Pre-requisites

Matrices, Determinants, Differentiation, Integration and Vector Algebra.

CO/PO Mapping

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

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

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

Instructional Strategy

- A theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-based.
- All demonstrations/Hands-on practices might be under a simulated environment.
- Use an inducto-deductive approach to achieve the desired learning objectives.
- Use open-ended questions to nurture the problem-solving and reasoning skills among students.
- Support and guide the students for self-study.
- State the need for mathematics with engineering studies and provide real-life examples.

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

Assessment Methodology

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

6000236111	**Advanced Engineering Mathematics**	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 each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

Unit I	**EIGENVALUES AND EIGENVECTORS**	
Characteristic equation – Eigen-values of *2* × *2* and *3* × *3* real matrices – Eigenvectors of *2* × *2* real matrices – Properties of eigen-values (excluding proof) – Cayley-Hamilton theorem (excluding proof) – Simple problems.		7
Unit II	**FUNCTIONS OF SEVERAL VARIABLES**	
Partial derivatives of two variable and three variable functions (up to second order) – Homogeneous functions and Euler's theorem (excluding proof) – Jacobian matrix and determinant – Maxima and minima of functions of two variables – Simple		7
problems.		
Unit III	**VECTOR CALCULUS**	

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

Scalar field and Vector field – Vector differential operator – Gradient of a scalar field – Directional derivative – Divergence and curl of a vector field (excluding properties) – Solenoidal and irrotational vector fields – Simple problems.	7
Unit IV **DIFFERENTIAL EQUATIONS**	
Differential equation – Formation – Order and degree – Solution of a differential equation – Equations of first order and first degree – Variable separable method – Leibnitz's Linear equations – Second order equations of the form $(aD^2 + bD + c)y = e^{nx}$ where a, b, c and n are constants and the auxiliary equation $am^2 + bm + c = 0$ has only real roots) – Complementary function – Particular integral – General solution – Simple problems.	7
Unit V **LAPLACE TRANSFORMS**	
Definition of Laplace transform – Laplace transforms of standard functions - Linearity and change of scale property (excluding proofs) – First shifting property – Laplace transforms of derivatives – Properties (excluding proofs) – Inverse Laplace transforms – Properties (excluding proofs) – Solving first order ordinary differential equation using Laplace transforms – Simple problems.	7
Revision + Test	10
TOTAL HOURS	45

Suggested list of Students Activity,

- Demonstrate the applications of eigen-values in stability analysis, decouple of threephase systems and vibration analysis.
- Demonstrate maxima and minima of two variable functions using GeoGebra graphing calculator.
- Demonstrate solenoidal vector field and irrotational vector field using engineering applications.

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

- Demonstrate the applications of differential equations in solving engineering problems.
- Presentation /Seminars by students.
- Quizzes.

Reference Books:

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

Web Reference

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

END SEMESTER QUESTION PATTERN - Theory Exam

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

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

Instruction to the question setters.

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

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

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

Introduction

Development of a diploma curriculum is a dynamic process responsive to the society and reflecting the needs and aspirations of its learners. Fast changing society deserves changes in educational curriculum particularly to establish relevance to emerging socio-economic environments; to ensure equity of opportunity and participation and finally promote concern for excellence. In this context the course on entrepreneurship and start ups aims at instilling and stimulating human urge for excellence by realizing individual potential for generating and putting to use the inputs relevant to social prosperity and thereby ensuring good means of living for every individual, providing jobs and developing the Indian economy.

Course Objectives

After completing this subject, the student will be able to

- Acquire entrepreneurial spirit and resourcefulness
- Familiarize Acquire knowledge about the business idea and product selection
- Analyze the banking and financial institutions
- Understand the pricing policy and cost analysis
- Get knowledge about the business plan preparation

Course Outcomes

CO1: Explain the process of entrepreneurship

CO2: Analyse the importance of generation of ideas and product selection

CO3: Familiarization of various financial and non financial schemes

CO4: Acquire various cost components to arrive pricing of the product CO5: Learn the preparation of project feasibility report

Pre-requisites

Knowledge of basics of Engineering and Industrial engineering

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping

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

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

Instructional Strategy

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and applications to help students understand and appreciate course concepts.

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.
- Application-Based Learning: Employ a theory-demonstrate-practice- activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real- world scenarios when possible.

Assessment Methodology

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

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

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

CA1and CA2, Assessment test should be conducted for two units as below.
(5 X 10 Marks = 50 Marks).

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

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

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

Question Pattern:

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

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

Syllabus Contents

Unit I	**Entrepreneurship – Introduction and Process**	
Concept of entrepreneurship - Importance, Myths about Entrepreneurship, Pros and Cons of Entrepreneurship, Process of Entrepreneurship, , Competencies and characteristics of an entrepreneur -, Ethical Entrepreneurship, Entrepreneurial Values and Attitudes, Creativity, Innovation and entrepreneurship- Entrepreneurs - as problem solvers, Mindset of an employee and an entrepreneur, - Risk Taking- Concepts		7
Unit II	**Business Idea**	

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

Types of Business: Manufacturing, Trading and Services, Stakeholders: sellers, vendors and consumers and Competitors, E- commerce Business Models, business idea generation -Types of Resources - Human, Capital and Entrepreneurial tools and resources, etc.,- setting business goals- Patent, copyright and Intellectual property rights, Customer Relations and Vendor Management, -Business Ideas vs. Business Opportunities, Opportunity – SWOT ANALYSIS of a business idea - Business Failure – causes and remedies.- Types of business risks,	7

Unit III	**Banking**
Size and capital based classification of business enterprises- Role of financial institutions, Role of Government policy, Entrepreneurial support systems, Incentive schemes for state government, and Incentive schemes for Central governments.	7
Unit IV	**Pricing and Cost Analysis**
Types of Costs - Variable - Fixed- Operational Costs - Break Even Analysis - for single product or service, -financial Business Case Study, Understand the meaning and concept of the term Cash Inflow and Cash Outflow- Pricing- Calculate Per Unit Cost of a single product, , Understand the importance and preparation of Income Statement, Prepare a Cash Flow Projection- Factors affecting pricing.- GST.	7
Unit V	**Business Plan Preparation**

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

Feasibility Report – Technical analysis, financial analysis- Market Research - Concept, Importance and Process- tools for market research- Market Sensing and Testing, Marketing and Sales strategy, Digital marketing, Branding - Business name, logo, tag line, Promotion strategy, Business Plan Preparation, -Concept and Importance, , Execution of Business Plan.	7
Revision + Test	10
TOTAL HOURS	45

Suggested list of Students Activity.

1. Students can explore app development or web design. They'll learn about technology, user experience, and marketing.
2. Hosting events, workshops, or conferences allows students to practice project management, networking, and marketing skills.
3. Encourage students to address social or environmental issues through innovative business solutions. This fosters empathy and creativity.
4. Part of entrepreneurship clubs or organizations provides networking opportunities, mentorship, and exposure to real-world challenges.
5. Competitions like business plan contests or pitch events allow students to showcase their ideas and receive feedback.
6. Students can create and sell handmade crafts, artwork, or other products. This teaches them about production, pricing, and customer relations.
7. Students can provide consulting services in areas they're knowledgeable about, such as social media marketing or financial planning.
8. Encourage students to create and manage their own small business or offer freelance services. This hands-on experience helps them understand various aspects of entrepreneurship.

Text and Reference Books:

1. G.K. Varshney, Fundamentals of Entrepreneurship, Sahitya Bhawan Publications, Agra., 2019.

6000236112	**Entrepreneurship**	L	T	P	C
THEORY		3	0	0	3

2. H.Nandan, Fundamentals of Entrepreneurship, Prentice Hall India Learning Private Limited, Third Edition, 2013.
3. R.K. Singal, Entrepreneurship Development & Management, S K Kataria and Sons, 2013.

Web Reference:

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

END SEMESTER QUESTION PATTERN - Theory Exam Duration: 3 Hours.
Maximum Marks: 100

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

Instruction to the question setters.

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

1221236113	ELECTIVE -3 (PATHWAY) APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

Introduction

Food processing and preservation is very vital in this urgent world. Various process industries, textile mills, hospitals and food processing industries utilize Refrigeration and Air Conditioning for its operations and processes. Hence it is very essential to study the various applications of R&AC in the present industrial growth and scenario.

Course Objectives

The objective of this course is to enable the student,

- Leverage expertise in refrigeration and food preservation techniques.
- Understanding the principles, techniques and technologies involved in food processing.
- Acquire knowledge about commercial refrigerators such as reach in cooler, walk in Coolers, display cases and blood bank refrigeration and preservation of viruses and tissues.
- Understand the application of refrigeration in industries.
- Learning the importance of maintaining indoor air quality in hospitals for patient safety and healthcare.

Course Outcomes

After successful completion of this course, the students should be able to CO1: Describe the refrigeration application in food preservation.

CO2: Discuss the use of refrigeration in food processing.

CO3: Describe the refrigeration application in commercial areas.

CO4: Know the use of HVAC in industries.

CO5: Describe the indoor air qualities in hospitals.

Pre-requisites

Basic knowledge in Refrigeration and Air Conditioning

CO/PO Mapping

1221236113	ELECTIVE -3 (PATHWAY) APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

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

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

Instructional Strategy

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia, and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- 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.

1221236113	**ELECTIVE -3 (PATHWAY)** **APPLICATION OF HVAC SYSTEM**	L	T	P	C
THEORY		3	0	0	3

Assessment Methodology

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

1221236113	ELECTIVE -3 (PATHWAY) APPLICATION OF HVAC SYSTEM	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 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	**REFRIGERATION APPLICATIONS & FOOD PRESERVATION**	
Refrigeration Applications- Classification of refrigeration applications – Domestic refrigeration, commercial refrigeration, Industrial refrigeration, Marine refrigeration and transportation refrigeration. Food preservation Objectives of food preservation – preservation in edible condition, preserving quality, appearance, odour, taste and vitamin content. Factors contributing to food spoilage – causes of food spoiling – enzymes and micro-organisms – bacteria, yeasts and molds control of spoilage agents. Freezing methods of food preservation and Applications		9
Unit II	**FOOD PROCESSING & PRESERVATION BY REFRIGERATION**	
Candy – manufacture and storage conditions, meat products – chilling, processing & storage conditions. poultry products – chilling, freezing & storage conditions. Fishery products –processing, preservation and transportation of fresh and frozen fish and their products – icing of fish. Individual quick freezing, contact plate freezers, air – blast freezers and immersion freezers.		9

1221236113	ELECTIVE -3 (PATHWAY) APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

Dairy products – pre cooling for separation and blending, pasteurization process, equipments used. Butter separation & storage.		
Unit III	**COMMERCIAL APPLICATIONS**	
Commercial refrigerators – construction and working of reach in refrigerators, walk in coolers and display cases. Factors considered in designing air conditioning of hotels and restaurants. Air conditioning of departmental stores – Indoor and Outdoor conditions – Types of air conditioning system used – Essential features of air conditioning system used - Design data for different types of shops in departmental stores. Air conditioning of theatres and auditoriums – Important heat load considered – Common design condition – Ventilation requirements.		9
Unit IV	**INDUSTRIAL APPLICATIONS OF AIR CONDITIONING**	
Industrial applications – Importance of RH in different industries – Equilibrium moisture content – Regain. Ice cream manufacture – Mixing and pasteurizing - Freezing – Process flow diagram for manufacture of ice cream. Refrigeration for liquified natural gas (LNG) – Gas liquification process for LNG. Textile industry air conditioning – Requirements and equipments. Functions of Air Handling units - construction and working of AHU and Application.		9
Unit V	**APPLICATIONS OF AIR CONDITIONING IN HOSPITALS & AIR DISTRIBUTION**	

1221236113	ELECTIVE -3 (PATHWAY) APPLICATION OF HVAC SYSTEM	L	T	P	C
THEORY		3	0	0	3

Necessity -Requirements of air conditioning system for different departments – Diagnostic and treatment department – Nursery department – Surgical department – Emergency department – Service Department – Recovery rooms. Blood bank refrigeration – Storage temperature and equipments. Preservation of tissues – Storage temperature. Preservation of virus – Storage temperature and application – Effect of refrigeration on Blood, Tissues and Virus.	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 list of area of application of HVAC.
2. Presentation/Seminar by students on factors contributing to food spoilage.
3. Presentation/Seminar by students on pasteurization process.
4. Presentation/Seminar by students on air conditioning in ICU ambulance.

Reference Books:

1. Refrigeration and Air – Conditioning by Arora and Domkundwar, DanpatRai& Sons Publications.
2. Refrigeration and Air – Conditioning by Khurmi and Gupta, S.Chand Publications.
3. Principles of Refrigeration by Roy J Dossot, Wiley International Edition.
4. Refrigeration and Air Conditioning – A.S.Sarao & G.S. Gabi, 6th edition, Satya Prakashan publications, New Delhi, 2004.
5. Principles of Refrigeration – Roy J.Dossat, 5th edition, Pearson Publications, 2001

Web Reference

- NPTEL Portal - www.nptel.ac.in
- ISHRAE Chapter - Indian Society of Heating, Refrigerating and Air-Conditioning Engineers

1221236113	ELECTIVE -3 (PATHWAY) APPLICATION OF HVAC SYSTEM	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.

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

Introduction

This course gives a deep insight into the finance fundamentals such as money management and the process of acquiring needed funds. It also encompasses the oversight, creation, and study of money, banking, credit, investments, assets, liabilities that make up financial systems and improves overall financial literacy.

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1: Manage financial resources effectively to achieve personal goals

CO2: Explain the procedure for Business Funding

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

CO4: Differentiate the types of budgeting and allocate the resources CO5: Apply the idea of marginal costing in decision making

Pre-requisites

Knowledge of basic mathematics

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

CO/PO Mapping

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

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

Instructional Strategy

- Engage and Motivate: Instructors should actively engage students to boost their learning confidence.
- Real-World Relevance: Incorporate relatable, real-life examples and applications to help students understand and appreciate course concepts.
- Interactive Learning: Utilize demonstrations and plan interactive student activities for an engaging learning experience.

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

- Application-Based Learning: Employ a theory-demonstrate-practice- activity strategy throughout the course to ensure outcome-driven learning and employability.
- Simulation and Real-World Practice: Conduct demonstrations and hands-on activities in a simulated environment, transitioning to real- world scenarios when possible.

Assessment Methodology

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

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

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

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

(5 X 10 Marks = 50 Marks).

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

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

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

Question Pattern:

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

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

Syllabus Contents

UNIT I	**Personal Finance**	
Personal Finance – Meaning, Objectives and advantages – Individual Perspective – Family Perspective – Time Value of Money – Personal Savings: Meaning, Different modes of Saving – Bank Deposit, Online Investments, Insurance, Stocks, Gold, Real Estate – Returns Vs Risk – Financial Discipline – Setting Alerts for commitments (With Real time Examples).		7

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

UNIT II	**Business Funding**	
Sources: Personal Savings – Borrowings - Venture Capital – Venture Capital Process – Commercial Banks – Government Grants and Scheme.		7
UNIT III	**Finance language**	
Capital – Drawing – Income – Expenditure – Revenue Vs Capital Items – Assets – Fixed Assets – Current Assets – Fictitious Assets – Liabilities – Long-term Liabilities – Current Liabilities – Internal Liabilities – External Liabilities – Shareholders fund: Equity Share capital, Preference Share Capital, Reserve & Surplus – Borrowings: Debentures, Bank Loan, Other Loan – Depreciation – Reserve Vs Provision.		7
UNIT IV	**Budgeting**	
Budgetary Control – Meaning – Preparation of various budgets – Purchase budget – Sales Budget – Production budget – Cash Budget – Flexible budgets. (With Problems)		7
UNIT V	**Marginal Costing**	
Marginal Costing – Meaning – Marginal Costing Vs Absorption Costing – Concepts of Variable Cost, Fixed Cost and Contribution – PV Ratio – Break Even Point – Margin of Safety – Key Factor – Application of Marginal Costing in decision making – Make or Buy – Shutdown or Continue – Exploring New Markets (With Problems)		7
	Revision + Test	10

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

Suggested list of Students Activity, Financial

Statement Analysis:

- Activity: Analyze and interpret financial statements, including balance sheets, income statements, and cash flow statements of different companies.
- Purpose: This activity helps students understand the financial health and performance of organizations, developing skills in financial analysis and critical thinking.

Investment Portfolio Management:

- Activity: Create and manage a simulated investment portfolio, making decisions on asset allocation, stock selection, and diversification.
- Purpose: This allows students to apply theoretical concepts in a practical setting, learning how to evaluate investment opportunities and manage financial risk.

Case Study Analysis:

- Activity: Examine real-world case studies involving financial decisions made by companies, such as capital budgeting, mergers and acquisitions, and financial restructuring.
- Purpose: Case studies provide insights into the application of finance principles in business scenarios, enhancing problem-solving and decision-making skills.

Classroom Discussions and Debates:

- Activity: Participate in discussions and debates on current financial issues, market trends, and economic policies.
- Purpose: Engaging in discussions helps students stay informed about the latest developments in finance, develop their communication skills, and form well-rounded opinions on financial matters.

Reference Books:

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

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

3. Management Accounting by T.S.Reddy and Dr.Y.Hariprasd Reddy, Margham Publications.
4. Cost Accounting by T.S.Reddy and Dr.Y.Hariprasd Reddy, Margham Publications.

END SEMESTER QUESTION PATTERN - Theory Exam

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

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

Instruction to the question setters.

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

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

Introduction

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

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

Course Objectives

The objective of this course is to prepare the student,

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

Course Outcomes

On successful completion of this course, the student will be able to, CO1:
Describe the Industry 4.0 technology and Industrial Internet of Things CO2:
Explain the Artificial Intelligence (AI) and Future Prospects of AI.
CO3: Explain Robotic Process Automation (RPA) for Manufacturing Industry
CO4: Describe Augmented & Virtual Reality and its Applications.
CO5: Explain the applications of IoT, Sensors, and Actuators in industries

Pre-requisites

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

Basic Knowledge of Industry 4.0 and its Applications

CO/PO Mapping

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

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

Assessment Methodology

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

	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.

1020236115	**Industry 4.0**	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 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 Industry 4.0**

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

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

Unit V:	**IoT, Sensors and Actuators**

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

Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT – Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT Analog and Digital Sensors – Interfacing temperature sensor, ultrasound sensor and infrared (IR) sensor with Arduino – Interfacing LED and Buzzer with Arduino.	7
Assessment Test and Revision with Student activity	10
Total	45

Textbook:

1. Sudip Misra, Chandana roy, and Anandarup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, Taylor & Francis India, 2021.
2. Dr Anand Kumar Singh and Dr. Manish Gangil, INDUSTRY 4.0, Shashwat Publication, 2022.
3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017.
4. Dr Kamlesh Lakhwani, Dr Hemant Kumar Gianey, Joseph Kofi Wireko, and Kamal Kant Hiran, Internet of Things (IoT), First Edition, BPB Publications, 2020.

Website links for reference:

- https://www.youtube.com/playlist?list=PLbRMhDVUMngdcLdH4-YF1uJI4IuhcDZPR

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

END SEMESTER QUESTION PATTERN - Theory Exam

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

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

Instruction to the Question Setters

Four questions will be asked from every unit, students should write any two questions for 10 marks. The question may have two subdivisions only.

1020236116	**Additive Manufacturing**	L	T	P	C
THEORY		3	0	0	3

Introduction

This course is mainly designed to have a complete knowledge about Additive Manufacturing technologies which is a main component among the nine pillars of Industrie 4.0. This course is suitable for students opting for any pathway under Diploma in Mechanical Engineering stream. This course enhances the technical skills of students such as newer product design, testing and validation, problem solving, innovation, etc.

Course Objectives

1. To impart the knowledge of construction and working principles of additive manufacturing technologies, and their potential applications in design and manufacturing.
2. To familiarise with the materials used in AM processes and their applications

Course Outcomes

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

CO1: Explain the additive manufacturing technologies and rapid prototyping
CO2: Acquire the CAD model generation procedure for the AM processes
CO3: Explain extrusion and sheet metal based AM processes
CO4: Describe photo polymerization and powder based AM processes CO5: Enlighten the various applications of AM processes

Pre-requisites

Knowledge of basic Science, Manufacturing Processes, Machine Tool Technology

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

CO/PO Mapping

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

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

Instructional Strategy

- Prepare case study problems to the realistic situations, and real-world examples to make the sessions engaging.
- Additive Manufacturing processes can be displayed via online or offline mode to gain the interest for this course.
- Different methods of teaching such as debate and discussions can be used to enhance the students' centric learning.
- Organise demo sessions on the 3D printing machines that are available in the institution or can be call some vendor for giving demos

Assessment Methodology

1020236116	**Additive Manufacturing**	L	T	P	C
THEORY		3	0	0	3

	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.

1020236116	**Additive Manufacturing**	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 each. Four questions will be asked from every unit, students should write any two questions. The question may have two subdivisions only.

Syllabus Contents

Unit I	**Introduction to Additive Manufacturing (AM)**	
Additive Manufacturing - Overview – Need – History – Classification – working principles (concepts only) - Materials for AM – PLA, ABS, PMMA, ceramics, composites and liquid resins – AM processes - Advantages, Limitations and Challenges– Rapid Prototyping – Rapid Tooling.		6
Unit II	**Design for Additive Manufacturing**	
Basic concept – CAD model preparation - file formats - Part orientation – Support material generation – Model slicing – honeycomb structure - Digitization techniques – Model reconstruction – Slicing software - Reverse Engineering – RE application in AM.		6
Unit III	**Extrusion and Sheet metal based Processes**	
Fused Deposition Modeling (FDM) – construction, working principle, advantages – process parameters involved - Laminated Object Manufacturing (LOM) – construction, working principle, advantages - gluing and adhesive bonding - PolyJet - construction, working principle, advantages.		6
Unit IV	**Photo polymerization and Powder based Processes**	
Stereolithography process (SLA) – construction, photo curable materials, working principle, advantages – Selective Laser Sintering (SLS) - construction, working principle, advantages –		6

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

Electron Beam Melting (EBM) - construction, working principle, advantages – Laser Engineered Net Shaping (LENS) - construction, working principle, advantages.	
Unit V **Applications of Additive Manufacturing**	
Applications of Additive manufacturing technologies – new product development - after sales and service - automobile, aerospace, consumer products, health care industries – customized implants, bio-organs, bio-bones, etc.	6
Assessment Test and Revision with Student activity	15
Total	45

Suggested list of Students Activity,

- Selected topics which are relatively simpler or descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Mini-projects may be given to a group of students for hand-on experiences.
- Massive open online courses (MOOCs) may be used to teach various topics/subtopics.

Reference Books:

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
3. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.
4. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
5. Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2000.
6. Tom Page “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012.

Web Reference

1020236116	Additive Manufacturing	L	T	P	C
THEORY		3	0	0	3

What is 3D printing? How does a 3D printer work? Learn 3D printing

3D Printing - Applications, Types, Process, Advantages (vajiramandravi.com)

How a 3D Printer Works and What It Is Used for (spiceworks.com)

What is 3D Printing? - Technology Definition and Types - TWI (twi-global.com)https://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdfhttps://web.mit.edu/tdp/www/whatis3dp.html

Briefing Note (birmingham.ac.uk)

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.

1020236117	Power Plant Engineering	L	T	P	C
THEORY		3	0	0	3

Introduction

Electrical power is the main resource for any type of industry. Economic growth of the nation essentially results in growth in the power sector. Various conventional power plants such as Hydro, Gas, Thermal, Diesel and Nuclear power plants are employed for power generation. Most of the power plants use Mechanical Engineering equipment and components. Hence, this course attempts to provide the basic knowledge of the components, operation and maintenance of power plants to the students and would also acquaint them with the latest technological advances taking place in this sector.

Course Objectives

The objective of this course is to enable the student to apply knowledge of mechanical engineering related to power generation systems, their control and economics in different types of power plants for their operation and maintenance.

Course Outcomes

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

CO1: Analyze economics of power plants and list factors affecting the power plants and interpret the performance of power plants based on load variations CO2: Identify elements and their functions and operation of thermal power plants. CO3: Identify elements and their functions of hydro, Solar and wind power plant.

CO4: Identify elements and their functions and operations of nuclear power plants CO5: Identify elements and their functions and operations of diesel and gas turbine power plants

Pre-requisites

Knowledge of Mathematics, Thermal Engineering, Mechanics of machines, Workshop technology, Fluid mechanics and fluid power.

CO/PO Mapping

1020236117	Power Plant Engineering	L	T	P	C
THEORY		3	0	0	3

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

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

Instructional Strategy

1. The instructional strategy for teaching Powerplant Engineering in polytechnic colleges emphasizes practical application and industry relevance.
2. 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.
3. About 15 – 20% of the topics/ sub-topics which are relatively simpler or descriptive in nature is to be given to the students for self-directed learning and assess the development of the Cos through classroom presentations.
4. Before starting practical, the teacher should demonstrate the working of a power plant.
5. Show video/ animation films to explain the functioning of various power plants.

Assessment Methodology

	Continuous Assessment (40 marks)	End Semester

1020236117	**Power Plant Engineering**	L	T	P	C
THEORY		3	0	0	3

	CA1	**CA2**	**CA3**	**CA4**	**Examination (60 marks)**
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.

1020236117	Power Plant Engineering	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	**INTRODUCTION & ECONOMICS OF POWER PLANT**
Power plant-Introduction, Classification - Location of power plant- Choice of Power plant- Terminology used in power plant: Peak load, Base load, Load factor, Load curve, demand factor- Various factor affecting the operation of power plant- Load sharing- cost of power tariff methods-factors involved in fixing of a tariff.	7
UNIT II	**THERMAL POWER PLANT**
Thermal power plant -General layout – working-Site Selection– materials required for thermal power plant - High Pressure Boilers and classification - coal handling and its methods, stages in coal storage- Fuel burning-Stoker firing-overfeed stoker –underfeed stokers-chain grate stoker, Pulverized fuel handling system- Pulverization of coal-Ash handling system- Gravity system- electrostatic precipitation (ESP) system-Advantages and disadvantages-limitations of Thermal power plant.	7

UNIT III	**POWER FROM RENEWABLE ENERGY**
Hydroelectric power plant- Introduction, storage and poundage, Selection of sites for hydroelectric power plant-General layout and essential elements of Hydroelectric power plant and its working- Advantages and limitations of hydroelectric power plant. Solar power plant-Introduction-layout, Solar cell fundamentals & classification – maximum power point tracker (MPPT) and solar panel. Wind power plant: Introduction, -Factors affecting	7

distribution of Wind energy, Variation of wind speed with height and time-Horizontal axis wind turbine (HAWT)-types of rotors-Vertical axis wind turbine- types of rotors- advantages and limitations of Wind power plant.	
UNIT IV **NUCLEAR POWER PLANT**	
Nuclear power plant-introduction-nuclear fuels, nuclear fission and fusion, working of a nuclear power plant, types of reactors- pressurized water reactor- boiling water reactor- CANDU type reactor – fast breeder reactor - effect of nuclear radiation- different methods for nuclear waste disposal-low, medium and high-level waste disposal, Advantages - disadvantages- limitations- Safety measures for Nuclear Power plants.	7
UNIT V **DIESEL POWER PLANT AND GAS TURBINE POWER PLANT**	
Diesel power plant- layout -Components and the working- Advantages -disadvantages- limitations. Gas turbine power plant- Schematic diagram & working of open and closed cycle gas turbine power plant, Components of Gas turbine–compressor, combustion chamber, gas turbine, vortex blading, gas turbine fuels, Gas turbine power plants in India- Advantages -disadvantages- limitations of Gas turbine power plant.	7
Revision + Test	10
Total	45

Suggested list of Students Activity,

Other than 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.

1. Students are advised to visit a nearby power plant to understand more about the subject and prepare a report consisting of
    a) Various advanced systems
    b) Various Standards
    c) Maintenance of components of power plant observed
2. Prepare/ Download the specifications of followings:
    a) Steam Power plant equipment and elements
    b) Gas turbine Power plant equipment and elements

1020236117	Power Plant Engineering	L	T	P	C
THEORY		3	0	0	3

c) Hydro Power plant equipment and elements

d) Diesel Power plant equipment and elements **Reference Books:**

1. Power plant engineering, G. R. Nagpal, Khanna publishers.
2. Power plant engineering, Arora and Domkundwar, Dhanpat rai & CO (P) LTD.
3. Power Plant Engineering, Dr. P. C. Sharma, S. K. Kataria & Sons Publications.
4. Power plant engineering, P. K. Nag, McGraw Hill India.
5. A Text Book of Power Plant Engineering, R K Rajput, Laxmi Publications.

Web reference

- https://www.youtube.com/playlist?list=PLLy_2iUCG87BT8H9uMufjrcPF5e6Qd2bz
- https://www.youtube.com/watch?v=3dJAtHaSQ98
- https://www.youtube.com/watch?v=kbuLfXgw4Gs
- https://www.youtube.com/watch?v=68-o35vWTAc
- https://www.youtube.com/watch?v=vrp0ptd03mg

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.

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

MEP Equipment servicing is required in a large number of commercial and industrial applications. This content would be useful in identifying the defects and servicing of MEP equipments. The knowledge and skill of various equipments of HVAC systems, electrical systems and plumbing systems will be very useful in maintaining MEP systems in commercial buildings

Course Objectives:

- To know the types of equipment's in HVAC systems.
- To know the functions of HVAC systems, electrical systems and plumbing systems.
- Practice with servicing of HVAC equipment in the industry.
- Describe the procedure for maintaining of MEP equipment.
- Practicing and servicing of electrical and plumbing equipment.

Course Outcomes

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

CO 1 : Describe the working of HVAC equipment in the industry.

CO 2 : Explain the function of electrical equipments and their periodic maintenance.

CO 3 : Describe the functions of plumbing systems and their service procedure

CO 4 : Demonstrate the skills in identifying and rectifying the defects in MEP equipments.

CO 5 : Explain the service procedure for MEP equipments in the industry.

Pre-requisites:

Thermodynamics, fundamentals of refrigeration and air-conditioning, functions of HVAC components

CO/PO Mapping

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

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

	Continuous Assessment (40 marks)				**End Semester**

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

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

Note:

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

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

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

Each 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.

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

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

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

SCHEME OF EVALUATION

PART	**DESCRIPTION**	**MARKS**
A	Aim & Tools required	10
B	Procedure / Sketch / Setting / Tool Handling	20
C	Adjustment / Dismantling / Assembling	20
TOTAL		50
D	Practical Documents (As per the portions)	10
		60

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

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

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

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

PART	**DESCRIPTION**	**MARKS**
A	Aim & Tools required	10
B	Procedure / Sketch / Setting / Tool Handling	20
C	Adjustment / Dismantling / Assembling	20
D	Troubles / Report	10
E	Written test (MCQ)	30
F	Viva Voce	10
TOTAL		100

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

Syllabus Contents

Theory Portion - Unit – I

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

Basic concept of thermodynamics – heat – temperature – pressure. Introduction of central plant air conditioning – DX system – Chilled water system – Air handling unit – fan coil unit – chilled water pump - water cooled chiller – air cooled chiller – cooling tower – construction and working – Maintenance schedule – servicing procedure	9
Practical Exercises	
Exercise 1: Water heater a. Drain your tank and remove sediment. b. Check your anode rod regularly, as it's an important part of the water heater. c. If you notice your water heater leaking, it may be caused by a loose drain valve. Tighten with a wrench until snug. d. Test the temperature release valve. e. Insulate its pipes and the heater.	5
Exercise 2: Water pump a. Dismantle and assemble a pump from the chilled water pipe line. b. Dismantle and assemble of pump casing c. Alignment of pump-motor shaft	
Exercise 3: Cooling Tower a. Check the fan motor assembly b. Align the fan motor assembly c. Check the float valve operation d. Check the water nozzles and replace if blocked.	5
Exercise 4: Plumbing pump a. Dismantling and assembly of pump casing b. Check and replace shaft seal c. Check and replace impeller	5

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

Exercise 5: Fire Fighting pumps	5
a. Check automatic start by opening a test line to reduce system pressure b. Verify that relief valves operate properly c. Check the fuel tank level for diesel pump d. Check the oil and fuel filter in the diesel engine e. Check the battery	

Theory Portion - Unit – II	
Electrical system – basics of electricity – electrical equipments – generator – transformer – water heater – working and construction – servicing and maintenance procedure Plumbing system – basics of fluid flow – hot and cold water – drainage system – water treatment plant – pumps – valves – strainer - servicing and maintenance procedure.	6
Practical Exercises	
Exercise 6: Cleaning AC Unit. a. Filter cleaning b. Cooling coil cleaning c. Blower cleaning d. Condenser coil cleaning e. Condenser fan cleaning	5

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

Exercise 7: Checking AC unit a. Checking refrigerant pressure b. Check the drier . c. Check the compressor. d. Check the temperature control. e. Check the supply air flow rate and temperature	5

Exercise 8: Transformer a. Check the transformer oil level and top up if required b. Clean the breather. c. Check the bushing filled with oil to check oil level d. Check the leakage of oil from any point e. Check the oil pump f. Check air fan	5
Exercise 9: Genset (Engine Generator) a. Test Batteries b. Check intake and exhaust c. Inspect wiring / electrical system	5
Exercise 10: Genset (Engine Generator) a. Check filters and replace if necessary b. Check oil and replace as recommended c. Check fuel filter and replace if blocked d. Check and replace spark plugs	5
Assessment Test and Revision	10
Total	75

Text and Reference Books:

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

1. ASHRAE Hand book Heating, Ventilating, and Air-Conditioning SYSTEMS AND EQUIPMENT
2. The Institute of Plumbing – Plumbing Engineering Services Design Guide
3. Principles of Electrical Engineering and Electronics by V.K Mehta and Rohit Mehta **Web References**

- https://www.youtube.com/watch?v=PVGWHysJj78
- https://www.youtube.com/watch?v=yEzCvjQ2sNY ●https://www.youtube.com/watch?v=q-Oooe0G7_c
- https://www.youtube.com/watch?v=Ct1WnU-q9Qs
- https://www.youtube.com/watch?v=-5ccNAHF7I8 ●https://www.youtube.com/watch?v=f0tKsDjWgT8
- https://www.youtube.com/watch?v=KTn2khCDqyw
- https://www.youtube.com/watch?v=8jxRn-T_LCs
- https://www.youtube.com/watch?v=cDnrpCX58bQ
- https://www.youtube.com/watch?v=_FyePOpQkNo
- https://www.youtube.com/watch?v=3Z7cEPQGX3E ●https://www.youtube.com/watch?v=ouKCbxuW4r4

Equipment / Facilities required to conduct the Practical Course.

MEP Equipment List

1. Generator
2. Fire pumps
3. Sump pumps
4. Water treatment plant
5. Plumbing pumps, valves and strainer
6. Exhaust fans
7. Dx AC units
8. PAC units

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

9. Air cooled chiller
10. Water cooled chiller
11. Chilled water pumps
12. Cooling tower
13. Condenser water pumps
14. Air separator

Based on the requirement the quantity should be kept.

END SEMESTER EXAMINATION - Practical Exam

Note:

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

SCHEME OF EVALUATION

Part	Description	Marks
A	Aim & Tools required	10
B	Procedure / Sketch / Setting / Tool Handling	20
C	Adjustment / Dismantling / Assembling	20
D	Troubles / Report	10
E	Written test (Theory Portions)	30

1020236241	**MEP Equipment Servicing**	L	T	P	C
PRACTICUM		1	0	4	3

F	Viva Voce	10
	TOTAL MARKS	100

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

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Diploma technocrats who are in the field of maintenance of machine tools should have a thorough knowledge about the dismantling and assembly procedure, installation, maintenance and repair of the machines and know about the technology used for the prediction of premature failure of components in advance.

Course Objectives:

- To know the instruments used for maintenance
- To know the advanced maintenance techniques of machine tools to increase the duration of life of the machines.
- To know the procedure for dismantling and assembly of equipment.
- To know the instruments used for machine tool testing.
- To know the different alignment techniques and accuracy of machine tools.

Course Outcomes

CO1: Setup instrument for machine tool maintenance.

CO2: Acquire knowledge of maintenance and troubleshooting of Machines and its components

CO3: Acquire knowledge for dismantling and assembly of equipment's

CO4: Setup instrument for machine tool testing

CO5. Acquire knowledge on machine tool alignment and the manufacturing accuracy of machine tools.

Pre-requisites:

Basic workshop practice, Workshop practices, Machine Tool Technology

CO/PO Mapping

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

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

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

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

Note:

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

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

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

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

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

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

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Dismantling / Procedure	20
B	Troubleshooting procedure/ Geometrical test	20
C	Assembling & Inspection Report / Test Chart	10
TOTAL		50
D	Practical Documents (As per the portions)	10
Total Marks		60

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

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

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

Question pattern – Written Test Theory

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

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

●**CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

PART	**DESCRIPTION**	**MARKS**
A	Aim & Tools Required	10
B	Dismantling / Procedure	20
C	Troubleshooting procedure/ Geometrical test	20
D	Assembling & Inspection Report / Test Chart	10
E	Written Test (Theory Portion)	30
F	Viva Voce	10

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3
TOTAL		100			

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

Syllabus Contents

Theory Portion	
MAINTENANCE ACTIVITY OF MACHINE TOOLS: Maintenance: Objective-Definition –Types of maintenance-Advantages of good maintenance-Disadvantages of bad maintenance-Instruments needed for maintenance. Maintenance of Lathe: Lathe maintenance-Drive belts- Adjusting belt tension, Gib adjustment(cross slide, Compound slide),Wiper pads, Adjusting the Tailstock clamp. **TESTING OF MACHINE TOOLS** Measuring Equipment and Tools used for testing of machine tools: Dial gauges – test mandrels – straight edges - squares- spirit levels- level measurement by water level- alignment by wire and measuring microscope. DETAILS FOR TESTING VARIOUS MACHINE TOOLS: Machine tool testing purpose-Types of geometrical checks on machine tools-Various test conducted on machine tools-Alignment test on lathe, surface grinding and milling machine.	15
Practical Exercises	
Maintenance:	
Exercise 1: Lathe maintenance-Drive belts- Adjusting belt tension, Gib adjustment (cross slide,Compound slide), Wiper pads checking, Adjusting the Tailstock clamp.	5
Exercise 2: Slotter maintenance- Diving Pulley alignment checking-Belt tension adjustment –Pinion gear inspection , table jib adjustment.	5

1020236242	**Maintenance of Machine Tools**	L	T	P	C
PRACTICUM		1	0	4	3

Exercise 3: Practice on oil removing & filling for a gear box. Inspection of the drained oil for contaminants & wear debris with focus on visual inspection. Preparation of coolants.	5
Exercise 4: Drawing and drafting of machine part as per requirement (in case of worn out/ modification)	5
Exercise 5: Dismantle, inspect and assemble the Lead screw and Half nut of the lathe.	5
Exercise 6: Dismantle, inspect and assemble the Three jaw chuck./Four jaw chuck	5
Exercise 7: Dismantle, inspect and assemble the Drill chuck.	5
Exercise 8: Surface roughness measurement on a machined component.	5
Machine Tool Alignment :	
Exercise 9: Conduct the following test for the surface grinding machine with horizontal grinding wheel spindle and prepare a test chart. a. Check the level of work table in longitudinal and transverse direction. b. Check the T-slots parallel with table movement. c. Check the T-slots square with transverse movement of table. d. Check the wheel spindle for true running and axial slip. e. Check the wheel spindle parallel with surface of table.	5

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

Exercise 10: Conduct the following test for the horizontal milling machine and prepare a test chart. a. Check the flatness of the work table surface in longitudinal and transverse direction b. Check the true running of the internal taper of main spindle c. Check the parallelism of the clamping surface of the work table in its longitudinal motion. d. Check the parallelism of the transverse movement of the work table to the main spindle in vertical and horizontal plane. e. Check the squareness of the table surface with column face.	5
Assessment Test and Revision	10
Total	75

Suggested List of Students Activity:

1. Students can visit the industry and workshops nearby and observe how the maintenance of machine tools were done.
2. Study the alignment test on machine tools such as Drilling and shaping.

Text and Reference Books:

1. Er.Sushil kumar Srivastava - Maintenance Engineering - Reprint2016 - S.Chand publication.
2. Georg Schlesinger, F. Koenigsberger , M. Burdekin - TESTING MACHINE TOOLS - 8th edition- Pergamon Press-1978.
3. K.J.Bag- Preventive Maintenance - ISTE Professional centre continuing education Programme- Distributed by ISTE Professional centre AnnaUniversity campus, Chennai.

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

Web-based/Online Resources:

- https://www.youtube.com/watch?v=f58SW0Hwcf0 –Principle of Maintenance –NPTEL- IIT Kharagpur

END SEMESTER EXAMINATION - Practical Exam

Note:

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Tools Required	10
B	Dismantling / Procedure	20
C	Troubleshooting procedure/ Geometrical test	20
D	Assembling & Inspection Report / Test Chart	10
E	Written Test (Theory Portions)	30

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

F	Viva Voce	10
TOTAL		100

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

Equipment / Facilities required to conduct the Practical Course.

S.No	Name of the Equipment's	Quantity Required
1.	Lathe machine	1 No
2.	Surface grinding machine	1 No
3.	Milling machine	1 No
4.	Slotting Machine	1 No
5.	Surface roughness tester	1 No
6.	Lead screw and nut	1 No
7.	Three jaw chuck/ Four jaw chuck	1 No

1020236242	Maintenance of Machine Tools	L	T	P	C
PRACTICUM		1	0	4	3

8.	Drill chuck	1 No
9.	Dial gauge	5 Nos.
10.	Magnetic stand	5 Nos.
11.	Surface gauges	5 Nos.
12.	Spirit level	5 Nos.
13.	Spanners (DE/Ring/Box)	Sufficient quantity
14.	Screw drivers	Sufficient quantity
15.	Allen screw sets	Sufficient quantity
16.	Hammer	Sufficient quantity
17.	Test mandrels	Sufficient quantity
18.	Squares / Blocks	Sufficient quantity

1020236243	**NON DESTRUCTIVE TESTING**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Non-destructive testing (NDT)is a multidisciplinary profession that blends quality assurance and materials science. NDT is used to inspect and evaluate materials, components, or assemblies without destroying their serviceability. Through a set of test methods, skilled technicians identify cracks, voids, inclusions, and weld discontinuities, as well as identify misassembled subcomponents. This makes NDT crucial to help prevent catastrophic failures such as airplane and locomotive crashes, pipeline leaks and explosions, nuclear reactor failures, and ship disasters.

Course Objectives:

The objective of this course is to prepare the student,

- To learn about the various Non Destructive testing methods.
- To identify the types of equipment used for each Non-Destructive and Destructive Examination.
- To study about the process of Surface Testing Methods(LPT & MPT)
- To learn about the Sub Surface Testing methods(RT & UT)
- To study about the various applications of NDT Tests in Industries.

Course Outcomes

CO1: Explain NDT techniques which enable it to carry out various inspections in accordance with the established procedures.

CO2: Calibrate the instrument and inspect for in-service damage in the components.

CO3: Differentiate various defect types and select the appropriate NDT methods for better evaluation.

CO4: Communicate their conclusions clearly to specialist and non-specialist audiences.

CO5: Prepare the testing and evaluation of the results for further analysis.

Pre-requisites:

Knowledge of basic measuring instruments, material processing, and various types of materials defects.

CO/PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7

1020236243	NON DESTRUCTIVE TESTING	L	T	P	C
PRACTICUM		1	0	4	3

CO1	3	-	-	3	-	-	-
CO2	3	-	-	3	-	-	-
CO3	3	-	-	3	-	-	-
CO4	3	-	-	3	-	-	-
CO5	3	-	-	3	-	-	-

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

Instructional Strategy:

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

Assessment Methodology:

	Continuous Assessment (40 marks)				**End Semester**

1020236243	**NON DESTRUCTIVE TESTING**	L	T	P	C
PRACTICUM		1	0	4	3

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

Note:

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

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

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

Each 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.

1020236243	NON DESTRUCTIVE TESTING	L	T	P	C
PRACTICUM		1	0	4	3

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

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	15
B	Observation / Sketch	20
C	Accuracy	15
TOTAL		50
D	Practical Documents (As per the portions)	10
		60

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

Cycle - II - Exercise 5, 6, 7 and 8..

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

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks

1020236243	**NON DESTRUCTIVE TESTING**	L	T	P	C
PRACTICUM		1	0	4	3

Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

PART	**DESCRIPTION**	**MARKS**
A	Procedure/Preparation	15
B	Observation/Drawing	20
C	Accuracy	15
D	Result	10
E	Written Test	30
F	Viva Voce	10
TOTAL		100

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

Syllabus Contents

Theory Portion - Unit I

1020236243	**NON DESTRUCTIVE TESTING**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction: Non destructive testing (NDT) and its comparison with destructive testing, Defects/ flaws due to primary processing, secondary processing and inservice, Types of defects determined by NDT, Common non-destructive testing techniques, Advantages, limitations and applications of NDT. **Visual Inspection:** Principle of visual Inspection, Defects which can be detected by unaided visual Inspection, Optical aids used for visual inspection, Advantages and limitations of visual inspection. **Liquid Penetrant Test:** Advantages and limitations of Liquid Penetrant Test (LPT), Physical principles of LPT, Procedure employed for LPT, Penetrant methods, Materials used in LPT. **Magnetic Particle Test:** Advantages and limitations of Magnetic Particle Test (MPT), Procedure of MPT, Magnetizing Magnetic particles and suspending liquids, Detectable discontinuities, Non-relevant indications, Applications.	8
Practical Exercises	
Exercise 1: Detect the cracks in the specimen using Visual Inspection and ring test.	6
Exercise 2: Detect the Small surface flaws in the specimen using Microscopy Examination test.	6
Exercise 3: Detect the Subsurface flaws in the specimen using Radiography.	6
Exercise 4: Detecting Surface flaws in specimen using Die-penetration test.	6
Theory Portion - Unit II	

1020236243	**NON DESTRUCTIVE TESTING**	L	T	P	C
PRACTICUM		1	0	4	3

Eddy Current Test: Advantages and limitations of Eddy Current Test (ECT), Operation variables, Eddy current instrumentation, Reference standards, Applications. **Ultrasonic Test:** Advantages and limitations of Ultrasonic Test (UT), General characteristics of ultrasonic waves, Wave propagation and types of ultrasonic waves, Major variables in UT, Angle beam techniques, Immersion testing, Applications. **Radiography Test:** Uses/ Applicability of radiography, Advantages and limitations of Radiography Test (RT), Interaction between penetrating radiation & matter (Attenuation), Image conversion media, Film radiography, Real time radiography. **Other Non-destructive Inspection Techniques:** Acoustic emission inspection, Microwave inspection, Thermal inspection, Electromagnetic techniques for residual stress measurements, Optical holography, etc.	7
Practical Exercises	
Exercise 5: Detect of Surface flaws in specimen using Ultrasonic test.	6
Exercise 6: Detect the cracks in specimen using Magnetic particle test.	6
Exercise 7: Detect the Surface and near surface flaws in specimen using Eddy Current test.	6
Exercise 8: Case Study experiment - Can analyze entire structure of Any one used machine components using Acoustic emission test.	6
Assessment Test + Revision	12
Total	75

TEXT BOOKS

1020236243	NON DESTRUCTIVE TESTING	L	T	P	C
PRACTICUM		1	0	4	3

1. "Non Destructive Evaluation and Quality Control", Metals Handbook, Vol. 17, 9th Ed., ASM.1989
2. Srivastava, K.C., "Handbook of Magnetic Particle Testing", Oscar publications. 1998
3. Hull, B., "Non Destructive Testing", Springer. 2012
4. Dr.V.Jayakumar,Dr.K.Elangovan"Non-Destructive Testing of Materials"Lakshmi Publications,Chennai,2017
5. Baldev Raj, Jayakumar T, Thavasimuthu M, Practical Non- Destructive Testing, 3rd Ed., Narosa. 2019

Web-based/Online Resources:

- www.ndt-ed.org
- www.krautkramer.com.au
- https://onlinecourses.nptel.ac.in/noc23_mm05

END SEMESTER EXAMINATION - Practical Exam

Note:

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure/Preparation	15
B	Observation/Drawing	20
C	Accuracy	15

1020236243	**NON DESTRUCTIVE TESTING**	L	T	P	C
PRACTICUM		1	0	4	3

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

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

1221236244	**ELECTIVE -4 (SPECIALZATION)**	L	T	P	C
PRACTICUM	**AUTOMOBILE ENGINEERING**	1	0	4	3

Introduction:

AutomobileEngineeringis designed to provide the students with a comprehensive understanding of the principles, technologies, and practices that drive the automotive industry forward. Whether the students are a budding engineer, a seasoned enthusiast, or simply curious about how vehicles operate, this course will offer a journey into the heart of automotive design, manufacturing, and innovation.

Course Objectives:

The objective of this course is to enable the student to

- Understanding the key components of IC Engines and Cooling systems.
- Exploring the importance of lubrication system in IC Engines and Fuel feed system.
- Developing the skills in integration of transmission and braking system of Vehicle system.
- Understanding the electrical system in Automobile and benefits
- Studying the advancement in current trend of E-Vehicle and its Types

Course Outcomes:

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

CO1: Identify IC engine components and describe cooling systems in automobile engines

CO2: Assembling and Disassembling of Engine and its Components in Hands on Practice

CO3: Servicing the Oil Pump, Fuel pump and well Versed in Lubrication and Fuel feed system.

CO4: Explain Transmission Components like Gear box (Assembling/Disassembling)

CO5: Explain the Current Trend in Automobile E-Vehicle Technology and its Nomenclature

Pre-requisites:

Basic Knowledge in IC Engines

CO/PO Mapping

1221236244	ELECTIVE -4 (SPECIALZATION)	L	T	P	C
PRACTICUM	AUTOMOBILE ENGINEERING	1	0	4	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

Assessment Methodology:

	Continuous Assessment (40 marks)	End Semester

1221236244	ELECTIVE -4 (SPECIALZATION) AUTOMOBILE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

	CA1	CA2	CA3	CA4	Examination (60 marks)
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	50% exercises	50% 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.

  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.

1221236244	ELECTIVE -4 (SPECIALZATION) AUTOMOBILE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

This documentation can be carried out in a separate notebook or printed manual or a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim and procedure	15
B	Dismantling/ assembling/ Removing, servicing and replacing components/ tracing of electrical system / detailed explanation for study experiment	30
C	Results	05
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.

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

1221236244	**ELECTIVE -4 (SPECIALZATION)**	L	T	P	C
PRACTICUM	**AUTOMOBILE ENGINEERING**	1	0	4	3

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

Part	**Description**	**Marks**
A	Aim and procedure	15
B	Dismantling/ assembling/ Removing, servicing and replacing components/ tracing of electrical system / detailed explanation for study experiment	40
C	Results	05
D	Written test (theory portions)	30
E	Viva voce	10
TOTAL MARKS		100

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

Syllabus Contents

Theory Portion		
Unit I	**IC ENGINES, COMPONENTS**	
IC ENGINES & COMPONENTS Classifications of IC Engines – four stroke petrol and diesel engines – two stroke petrol and diesel engines – comparison of four stroke and two stroke engines – basic engine fly wheel – cam shaft – valve and valve mechanism		3

1221236244	ELECTIVE -4 (SPECIALZATION)	L	T	P	C
PRACTICUM	AUTOMOBILE ENGINEERING	1	0	4	3

Unit II	LUBRICATION AND FUEL FEED SYSTEM	
LUBRICATION SYSTEM Purpose – types of lubricants –types of lubricating system – full pressure system – oil pumps – oil filters – full flow and by pass filter system – causes and remedies. **FUEL FEED SYSTEM** Layout of fuel feed system of petrol engine – types of fuel feed system– AC mechanical fuel pump – SU electrical pump – fuel filter air cleaners types.		3
Unit III	**TRANSMISSION SYSTEM**	
General arrangement of power transmission system –clutch function – components – types – single plate – multi plate clutch – clutch troubles and their causes – gear box – purpose – types – sliding mesh, constant mesh gear box. Tearing system -Drive line – propeller shaft – universal joint – cross type only – slip joint – final drive – function – types of gear arrangement.		3
Unit IV	**ELECTRICAL SYSTEM**	
Introduction of Electrical Equipment – types of battery- lead acid battery (only)- construction and operation of starter motor — over running clutch and Bendex drive – construction and operation Charging circuit – Dynamo and alternator construction and operation –. Types Ignition system — magneto coil and Electric coil ignition system.		3
Unit V	**E-VEHICLE TECHNOLOGY**	
Environmental impact and history: Air-pollution–History of Electric vehicles History of Hybrid Electric Vehicles– History of Fuel Cell Vehicles–Hybrid electric Vehicle (HEV)-Plug-in Hybrid Electric Vehicle (PHEV)-Battery Electric Vehicle (BEV)–Fuel Cell Electric Vehicle (FCEV)–Description-Advantages-Architecture of Hybrid Electric Drive Trains.		3

Practical Exercise		
Ex. No	Name of the Exercise	Hours

1221236244	ELECTIVE -4 (SPECIALZATION) AUTOMOBILE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

1	Dismantling and assembling of four stroke petrol engine and identification of parts.	4
2	Removing camshaft, replacing timing gears, removing valves, lapping and adjusting valve clearance.	4
3	Removing, servicing and replacing of fuel pump.	4
4	Removing, servicing and replacing of oil pump.	4
5	Removing and replacing of pressure plate and clutch plate, fingers adjustment.	4
6	Dismantling, inspecting and assembling of constant mesh gear box and find out the gear ratios.	4
7	Dismantling, overhauling and assembling of starter motor / alternator	4
8	Trace the automobile electrical system with respect to battery coil ignition system	4
9	Study of Environmental changes on using E-Vehicles	4
10	Study of the main parts and its function in Battery Electric Vehicle	4
	Practice + Continuous Test + Revision	20
	TOTAL HOURS	**75**

Suggested List of Students Activity:

1.Presentation/Seminar by students on auto transmission cars

Text and Reference Books:

1. Automobile Engineering, G.B.S.Narang, Khanna Publishers, NewDelhi.
2. Automotive Mechanics, William H.Crouse and Donald .L. Anglin, Tata McGraw– Hill Publishing Company Ltd, NewDelhi.

1221236244	ELECTIVE -4 (SPECIALZATION) AUTOMOBILE ENGINEERING	L	T	P	C
PRACTICUM		1	0	4	3

3. A Textbook of Automobile Engineering by R.K.Rajput, Second Edition 2016, Laxmi Publications.

Web-based Online Resources:

- NPTEL

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	Equipments	Nos
01	Cut section model of a 4-stroke petrol engine	1
02	4 stroke petrol OR diesel engine	1
03	AC mechanical fuel pump	1
04	Any one type of oil pump	1
05	Multi plate clutch OR Single plate clutch assembly	1
06	Constant mesh gear box	1
07	Starter motor OR Alternator	1
08	Petrol engine ignition system with wiring and battery – 1 No	1

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

Practical document should be submitted for the examination with a bonafide certificate.

1221236244	**ELECTIVE -4 (SPECIALZATION)**	L	T	P	C
PRACTICUM	**AUTOMOBILE ENGINEERING**	1	0	4	3

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim and procedure	15
B	Dismantling/ assembling/ Removing, servicing and replacing components/ tracing of electrical system / detailed explanation for study experiment	40
C	Results	05
D	Written test (theory portions)	30
E	Viva voce	10
TOTAL MARKS		100

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

1020236245	**PRODUCT DESIGN & DEVELOPMENT**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

A product is something sold by an enterprise to its customers. Product design deals with conversion of ideas into reality and, as in other forms of human activity, aims at fulfilling human needs. Product development is the set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of a product.

Course Objectives:

The objective of the course is

1. To excel in new product design and development through application of knowledge and practical skills.
2. To provide students with a solid foundation in mathematical modeling of engineering problems required for bringing new products fast into the market.
3. To provide students with required scientific and engineering knowledge so as to comprehend, analyze, design and create innovative products and solutions for real life problems.
4. To inculcate professional and ethical values in students and enable them to work in multidisciplinary teams.
5. To provide students an academic environment which can facilitate life-long learning needed for a successful career in new product development.

Course Outcomes:

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

CO1: Describe the characteristics used for product design and development.

CO2: Assess the customer requirements in product design.

CO3: Apply structural approach to concept generation, selection and testing.

CO4: Identify various aspects of design such as industrial design, design for manufacture, assembly, service and quality and product architecture.

CO5: Explain various principles and technologies used for the preparation of prototype.

1020236245	**PRODUCT DESIGN & DEVELOPMENT**	L	T	P	C
PRACTICUM		1	0	4	3

Pre-requisites:

Knowledge of basic Science: Design of machine elements, CAD/CAM and Product Life Cycle Management.

CO/PO Mapping

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

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

Instructional Strategy:

1. Real time product design should be shown through video.
2. The subject can Lecture Cum Demonstration basics.
3. Practical demonstrations should be organized (industrial Visit).

1020236245	**PRODUCT DESIGN & DEVELOPMENT**	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

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

Note:

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

Practical documents should be maintained for every experiment immediately after completion of the practice. The practical document should be submitted for the practical test. The same should be evaluated

for 10 Marks for each exercise/experiment. The total marks awarded should be converted to 10 Marks for the practical test as per the scheme of evaluation as below.

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

Each exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment. This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The Procedure, Sketch and Result / Output should be written by the student manually in the documents.

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	10
B	Step / Report	20
C	Presentation	20
	TOTAL	50
D	Practical Documents (As per the portions)	10
		60

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

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

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

Question pattern – Written Test Theory

Description		**Marks**	
Part – A	30 MCQ Questions.	30 X 1 Mark	30 Marks

1020236245	**PRODUCT DESIGN & DEVELOPMENT**	L	T	P	C
PRACTICUM		1	0	4	3

Part – B	7 Questions to be answered out of 10 Questions.	7 X 10 Marks	70 Marks
TOTAL			100 Marks

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment. **SCHEME OF EVALUATION**

Model Practical Examination and End Semester Examination - Practical Exam

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	10
B	Step / Report	20
C	Presentation	20
D	Result / output	10
E	Written Test	30
F	Viva Voce	10
	TOTAL	100

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

Unit I	**INTRODUCTION**
Theory: Product life cycle, Product policy of an organization, Selection of a profitable product, Product design process, New product strategy Idea generation, Screening Concept development, Testing Business analysis Product development testing and	3

1020236245	PRODUCT DESIGN & DEVELOPMENT	L	T	P	C
PRACTICUM		1	0	4	3

Analysis Commercialization Collaboration. Gantt chart product life cycle management.		
Practical: 1. Case studies related to Characteristics of successful product development, Design and development of products. 2. Case studies related to different Development Processes and Organizations.		10
Unit II	**PRODUCT PLANNING**	
Theory: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.		3
Practical: 3. Case studies related to the product planning process, identify opportunities. 4. Case studies related to Concept Generation, Concept Selection, Concept Testing.		10
Unit III	**IDENTIFYING CUSTOMER NEEDS**	
Theory: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications.		3
Practical: 5. Case studies related to Identifying Customer Needs. 6. Case studies related to Customer Product Specification.		10

1020236245	**PRODUCT DESIGN & DEVELOPMENT**	L	T	P	C
PRACTICUM		1	0	4	3

Unit IV	**CONCEPT GENERATION**	
Theory: Product implications of the architecture, establishing the architecture, variety and supply chain considerations. Industrial design: Assessing the need for		3
industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design. Design for manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors, service and quality.		
Practical: 7. Case studies related to Product Architecture. 8. Case studies related to Design for Manufacturing.		10
Unit V	**PROTOTYPING**	
Theory: Prototyping basics, principles of prototyping, technologies, planning for prototypes. Product development economics, Elements of economic analysis, base case financial mode, sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.		3
Practical: 9. Case studies related to Prototyping, Product Development Economics. 10. Field Visit Report manufacturing or assembling industry.(Automobile Industry – Minimum – 4 Hrs) – Report should include: various steps involved in product manufacturing or product assemble ...(not included in Practical Exam)		10
	Assessment + Revision	10
	TOTAL	75

Suggested List of Students Activity:

1020236245	PRODUCT DESIGN & DEVELOPMENT	L	T	P	C
PRACTICUM		1	0	4	3

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.

1. Online video demonstration.
2. Practical demonstration.
3. Automobile industry visit and prepare a report.

Involve students in trouble shooting activities either in group or individual.

Text and Reference Books:

1. Karl T Ulrich, Steven D Eppinger , " Product Design & Development." Tata McGrawhill New Delhi 2003
2. Hollins B & Pugh S "Successful Product Design." Butter worths London.
3. Bralla J G "Handbook of Product Design for Manufacture, McGrawhill NewYork.
4. A K Chitale and R C Gupta, Product Design and Manufacturing, 6th Edition, PHI, New Delhi, 2003.
5. Boothroyd G, Dewhurst P and Knight W, Product Design for Manufacture and Assembly, 2nd Edition, Marcel Dekker, New York, 2002.

Web-based/Online Resources:

https://archive.nptel.ac.in/courses/112/107/112107217/

End Semester Examination - Practical Exam Note:

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Procedure / Preparation	10
B	Step / Report	20

1020236245	**PRODUCT DESIGN & DEVELOPMENT**	L	T	P	C
PRACTICUM		1	0	4	3

C	Presentation	20
D	Result / output	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.

1221236246	**ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM**	L	T	P	C
PRACTICUM		1	0	4	3

Introduction:

Day by day, engineering and technology experiences tremendous growth. Design plays a major role in developing engineering and technology. The Heat transfer concepts are very much essential to design HVAC System for various specifications. The selection and design of system components will provide the students an opportunity to enrich their skills themselves for the industrial scenario.

Course Objectives:

The objective of this course is to enable the student to

- Understand the basic concept of conduction, heat transfer through slabs.
- Understand the basic concept of convection, heat transfer in laminar and turbulent flow.
- Study about the radiation and various insulating materials
- Understand the heat exchanger and working of heat exchanger.
- Study about system components, selection and design of compressor, condenser, expansion device and evaporator.

Course Outcomes:

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

CO1: Apply the knowledge of calculating conduction heat transfer through slabs.

CO2: Correlate the Newton's law of cooling with convection heat transfer.

CO3: Demonstrate the radiation heat transfer and insulating materials.

CO4: Know the concept of heat exchanger and solve the design problems.

CO5: Illustrate the system components, selection and design of compressors, condensers, expansion device and evaporator.

Pre-requisites:

Basic Knowledge in Thermodynamics

CO/PO Mapping

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their learning confidence.
- To help students learn and appreciate numerous concepts and principles in each area, teachers should provide examples from daily life, realistic situations and real-world engineering and technological applications.
- The demonstration can make the subject exciting and foster in the students a scientific mindset. Student activities should be planned on all the topics.
- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome-and employability-based.
- All demonstrations/Hand-on practices are under a simulated environment (may be followed by a real environment as far as possible).

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

Assessment Methodology:

	Continuous Assessment (40 marks)				End Semester
	CA1	**CA2**	**CA3**	**CA4**	**Examination (60 marks)**
Mode	Practical Test	Practical Test	Written Test Theory	Practical Test	Practical Examination
Portion	50% exercises	50% 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.

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

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

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 a file with documents. Students should write the procedure and draw the sketch manually. The detailed date of the practices and its evaluations should be maintained in the course logbook. The log book and the practical documents should be submitted for the verification by the Flying Squad and DOTE Official.

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim and procedure	10
B	Tabulation / Observation	25
C	Calculation	10
D	Results	05
E	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.

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

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

- **CA 4:** All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

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

Part	Description	Marks
A	Aim and procedure	15
B	Tabulation / Observation	25
C	Calculation	15
D	Results	05
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

Syllabus Contents

Theory Portion		
Unit I	**CONDUCTION**	
Introduction - Heat transfer – Modes of heat transfer – Fourier‘s Law of conduction – Definition for thermal conductivity – Definition for thermal resistance – heat flux definition- Conduction through plane walls and composite walls. Fins – types of fins – efficiency and effectiveness of fins – applications- no problems - no derivations.		3
Unit II	**CONVECTION**	

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

Introduction - Convection - Newton ‘s law of convection - convective heat transfer coefficient - types of convection – natural convection, forced convection – definition only. Dimensionless Numbers – Reynolds number, Prandtl Number, Nusselt Number, Grashoff Number, Rayleigh Number – definition only – laminar flow, turbulent flow – definition only.		3
Unit III	**RADIATION & INSULATION**	
Radiation – Emissive power – Emissivity – Stefan-Boltzmann law – Absorption, Reflection and Transmission of radiation – Black body concept 3 Insulation – Need – ideal properties – types of insulation materials		
Unit IV	**HEAT EXCHANGER**	
Introduction – functions of heat exchanger – parallel flow – counter flow – cross flow heat exchangers – mean temperature difference –Determination of heat transfer using LMTD method		3
Unit V	**HEAT TRANSFER IN CONDENSOR AND EVAPORATOR**	
Condenser function – types – air cooled condenser, water cooled condenser – procedure for calculating heat transferred through air cooled condenser and water-cooled condenser. Evaporator functions – types – procedure for calculating heat transfer through air cooled evaporator and water-cooled evaporator		3

Practical Exercise

Ex. No	Name of the Exercise	Hours
1	Study of heat transfer through different types of fins	4
2	Determination of heat transfer through composite wall.	4
3	Determination of thermal conductivity of metal rod.	4
4	Determination of thermal conductivity of insulator [Wood]	4

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

5	Determination of overall heat transfer coefficient of parallel flow heat exchanger.	4
6	Determination of overall heat transfer coefficient of counter flow heat exchanger.	4
7	Determination of effectiveness of cross flow heat exchanger.	4
8	Determination of heat transfer in air cooled condenser	4
9	Determination of heat transfer in air cooled condenser	4
10	Determination of heat transfer in evaporator	4
	Practice + Continuous Test + Revision	20
	TOTAL HOURS	**75**

Suggested List of Students Activity:

- Presentation/Seminar by students on heat exchangers **Text and**

Reference Books:

1. Heat and Mass Transfer by Sachdeva, New Age International Publishers
2. Heat and Mass Transfer by Domkundwar, Danpat Rai Sons Publications
3. Heat and Mass Transfer Data Book by C.P.Gothandaraman and S.Subramanian, New Age International Publishers **Web-based Online Resources:**

- https://youtu.be/jEV4MN-Fiws?si=A-pLMTTj2BgL67uS
- https://youtu.be/YQHwMhJB4Lo?si=mvpoETufLWuQACIm
- https://youtu.be/FTSBtx5jhaY?si=Z5Jggr5mWhBw3wL4

1221236246	ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM	L	T	P	C
PRACTICUM		1	0	4	3

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in practice/Board examinations)

Sl. No	Equipments	Nos
01	Heat transfer through composite wall experimental test rig	1
02	Heat transfer in metal rod experimental test rig	1
03	Experimental test rig for finding thermal conductivity of insulator (wood)	1
04	Parallel flow heat exchanger experimental setup	1
05	Counter flow heat exchanger experimental setup	1
06	Cross flow heat exchanger experimental setup	1
07	Experimental setup for determination of heat transfer in air-cooled condenser	1
08	Experimental setup for determination of heat transfer in water-cooled condenser	1
09	Experimental setup for determination of heat transfer in evaporator	1

END SEMESTER EXAMINATION – PRACTICAL EXAM

Note:

All the exercises should be given in the question paper and students are allowed to select by a lot or the question paper allotted from the DOTE shall be used.

Practical document should be submitted for the examination with a bonafide certificate.

1221236246	**ELECTIVE -4 (SPECIALZATION) HEAT TRANSFER IN HVAC SYSTEM**	L	T	P	C
PRACTICUM		1	0	4	3

SCHEME OF EVALUATION

Part	**Description**	**Marks**
A	Aim and procedure	15
B	Tabulation / Observation	25
C	Calculation	15
D	Results	05
E	Written test (theory portions)	30
F	Viva voce	10
TOTAL MARKS		100

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

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

Introduction:

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

Course Objectives:

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

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

Course Outcomes

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

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

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

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

CO4: Explain the principles of rapid prototyping

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

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

Pre-requisites:

Material Science, Machine Design, Machine Drawing andValue Engineering.

CO/PO Mapping

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

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

Instructional Strategy:

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

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

Assessment Methodology:

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

Note:

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

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

1020236247	**REVERSE ENGINEERING**	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 experiment. This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The Procedure, Sketch and Result / Output should be written by the student manually in the documents.

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

SCHEME OF EVALUATION

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

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

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

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

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

Question pattern – Written Test Theory

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

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment. **SCHEME OF EVALUATION**

Model Practical Examination and End Semester Examination - Practical Exam

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

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

TOTAL	100

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

Syllabus Contents

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

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

Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness –Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure	

Practical: **4.** Structural Rigidity Testing: Conduct bending and torsion tests on Automobile body frames to determine their structural rigidity. Compare different frame designs and materials to identify the most robust and lightweight options.		5
Unit IV	**RAPID PROTOTYPING(RP)**	
Theory:, Introduction, current RP techniques and materials, Stereo Lithography, Selective Laser Sintering, Fused Deposition Modeling, Three-dimensional Printing, Laminated Object Manufacturing, Multijet Modeling.		3
Practical: 5. Crash Testing Simulation: Utilize crash test dummies and acceleration sensors to simulate vehicle collisions. Study how different body designs and materials affect passenger safety and structural integrity during impact. 6. Prepare case study report - Rapid Prototyping – Any one mechanical Machine components (Impeller, Engine Block, Piston and Door Pad)		12
Unit V	**INDUSTRIAL APPLICATIONS**	
Theory: Reverse Engineering in the Automotive Industry; Aerospace Industry. Case studies and Solving Industrial projects in Reverse Engineering. Legality: Patent – Copyrights –Trade Secret – Third-Party Materials.		3

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

Practical: 7. Prepare case study report – Patent 8. Prepare case study report – Copy rights 9. Prepare case study report – Trade Mark	15
Assessment + Revision	**10**
TOTAL	**75**

Text and Reference Books:

1. Reverse Engineering: An Industrial Perspective by V. Raja and K. Fernandes, Springer- Verlag.Wego
2. Kevin Otto , “Product Design : Techniques in Reverse Engineering and New Product Development”, ISBN-13: 9788177588217, Dorling Kindersley
3. Robert Messler, “Reverse Engineering: Mechanisms, Structures, Systems & Materials”, McGraw Hill Education, ISBN: 9780071825160
4. Reverse Engineering by K. A. Ingle, McGraw-Hill.
5. Raja, Vinesh, Fernandes, Kiran J. , “Reverse Engineering An Industrial Perspective” ISBN 978-184628-856-2, Springer

END SEMESTER EXAMINATION - Practical Exam

Note:

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim & Apparatus Required	10
B	Procedure / Explanation	20

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

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

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

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

Introduction:

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

Course Objectives:

The objective of this course is to prepare the student,

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

Course Outcomes

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

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

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

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

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

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

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

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

Pre-requisites:

Knowledge of basic energy sources.

CO/PO Mapping

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

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

Instructional Strategy:

- It is advised that teachers take steps to pique pupils' attention and boost their curiosity to learn.
- Implement task-based learning activities where students work on specific tasks or projects.
- Incorporate technology tools and resources, such as online platforms, interactive multimedia and virtual communication tools, to enhance engagement and provide additional practice opportunities.
- Incorporate formative and summative assessments to gauge student progress and provide targeted feedback.

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

- Throughout the course, a theory-demonstrate-practice-activity strategy may be used to ensure that learning is outcome and employability based.
- All demonstrations/Hand-on practices may be followed in the real environment as far as possible.

Assessment Methodology:

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

Note:

CA1 and CA2: All the exercises/experiments should be completed as per the portions above and kept for the practical test. The students shall be permitted to select any one by lot for the test.

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

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 exercise should be completed on the day of practice. The same shall be evaluated for 10 marks on the day or next day of practice before commencement of the next experiment. This documentation can be carried out in a separate notebook or a printed manual or a file with documents. The Procedure, Sketch and Result / Output should be written by the student manually in the documents.

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

SCHEME OF EVALUATION

PART	DESCRIPTION	MARKS
A	Aim / Procedure	10
B	Block diagram / Explanation	20
C	Presentation / Report	20
TOTAL		50

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

D	Practical Documents (As per the portions)	10
		60

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

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

CA 3: Written Test for complete theory portions should be conducted for 100 Marks as per the question pattern below. The marks scored will be converted to 15 Marks for internal assessment. **Question pattern – Written Test Theory**

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

CA 4: All the exercises/experiments should be completed and kept for the practical test. The students shall be permitted to select any one by lot for the test. The practical test should be conducted as per the scheme of evaluation below. After completion of all the exercises the practical test should be conducted as per End Semester Examination question pattern scheme of evaluation. The marks awarded should be converted to 15 Marks for the internal assessment.

SCHEME OF EVALUATION

Model Practical Examination and End Semester Examination - Practical Exam

PART	**DESCRIPTION**	**MARKS**
A	Aim / Procedure	10
B	Block diagram / Explanation	20

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

C	Presentation / Report	20
D	Result / Output	10
E	Written Test (Theory Portions)	30
F	Viva Voce	10
TOTAL		100

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

Syllabus Contents

UNIT I	**SOLAR ENERGY & WIND ENERGY**

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

INTRODUCTION Overview of conventional & renewable energy sources, types of renewable energy systems, Future of Energy Use, Present Indian and international energy scenario of conventional and RE sources, Energy for sustainable development, Environmental Aspects of Energy, Limitations of RE sources. **SOLAR ENERGY & WIND ENERGY** Theory of solar cells - Concept of Solar PV systems - Flat plate and concentrating collectors, Solar PV Applications - solar heating/cooling technique, solar distillation and	7
solar drying, solar cookers. Energy from Wind - Horizontal axis Wind Turbine - Vertical Axis Wind Turbine - Wind Energy Conversion Systems	
Familiarization with Different Solar Energy Gadgets	
Exercise 1: Study of Solar Distillation System	5
Exercise 2: Performance test on Solar Cooker	5
Exercise 3: Performance analysis of Solar Water Heater	5
Exercise 4: Performance test on Solar Dryer	5
Exercise 5: Performance Evaluation on Solar Lighting System	5

UNIT II	**GEOTHERMAL ENERGY, BIOMASS, HYDROGEN STORAGE, ENERGY EFFICIENT SYSTEMS & GREEN MANUFACTURING SYSTEMS**

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

OCEAN ENERGY, BIO-MASS ENERGY & HYDROGEN PRODUCTION OTEC, Principles of utilization, setting of OTEC plants - Tidal and wave energy. Principles of bio-conversion - types of bio-gas digesters, gas yield, utilization for cooking, bio fuels, I.C. engine operation and economic aspects.Chemical Production of Hydrogen- Electrolytic Hydrogen- Thermolytic Hydrogen- Photolytic Hydrogen- Photobiologic Hydrogen Production **ENERGY EFFICIENT & GREEN MANUFACTURING SYSTEMS** Energy efficient motors, energy efficient lighting and control. Fuel cells- principle, thermodynamic aspects, selection of fuels & working of various types of fuel cells, Environmental friendly and Energy efficient compressors and pumps. Environmental impact of the current manufacturing practices and systems, benefits of green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, Sustainable green production systems - alternate casting and joining	8
techniques, zero waste manufacturing.	
Exercise 6: Study on the Production Process of Bio-Fuels	5
Exercise 7: Study on the Floating Drum & Fixed Drum Biogas Plants	5
Exercise 8: Study on the various Bio-mass energy conservation technologies.	5
Exercise 9: Study on Production Process of Briquettes	5
Exercise 10: Performance test on BIO Diesel using blend analyzer	5
Revision + Assessment Test	10

Text and Reference Books:

1. D. S. Chauhan & S. K. Srivastava, Non-Conventional Energy Resources, New Age International Private Limited, 4 th Edition, 2021.
2. John Twidell & Tony Weir, Renewable Energy Resources, Routledge; 3 rd Edition, 2015.

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

3. D.P. Kothari, K.C. Singal & Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning; 3 rd Edition, 2022.
4. Ritu Dogra, Renewable Energy and Green Technology, Brillion Publishing, 1 st Edition, 2023.
5. Soli J. Arceivala, Green Technologies, McGraw Hill Education (India) Private Limited, 1 st Edition, 2017.
6. Chandan Deep Singh & Harleen Kaur, Sustainable Green Development and Manufacturing Performance through Modern Production Techniques, Taylor &
   Francis Ltd, 1 st Edition, 2021.

Web and Online Resources

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

END SEMESTER EXAMINATION - Practical Exam

Note:

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

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

SCHEME OF EVALUATION

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

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

List of Equipment required.

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

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

1020236351	**Internship**	540 Periods	C
PROJECT			12

Introduction

Internships in educational institutions are designed to provide students with practical experience in their field of study and to bridge the gap between academic knowledge and professional practice.

Objectives

After completing Internship, Interns will be able to,

- Apply the theoretical knowledge and skill during performance of the tasks assigned in internship.
- Demonstrate soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship.
- Document the Use case on the assigned Task.
- Enable interns to apply theoretical knowledge gained in the classroom to realworld practical applications.
- Provide hands-on experience in the industrial practices.
- Develop essential skills such as communication, organization, teamwork, and problem-solving.
- Enhance specific skills related to the intern's area of focus.
- Offer a realistic understanding of the daily operations and responsibilities.
- Provide opportunities to work under the guidance of experienced supervisors and administrators.
- Allow interns to explore different career paths.
- Help interns make informed decisions about their future career goals based on first hand experience.

1020236351	**Internship**	540 Periods	C
PROJECT			12

- Facilitate the establishment of professional relationships with supervisor, administrators, and other professionals in the field.
- Provide access to a network of contacts that can be beneficial for future job opportunities and professional growth.
- Foster personal growth by challenging interns to step out of their comfort zones and take on new responsibilities.
- Build confidence and self-efficacy through successful completion of internship tasks and projects.
- Give insight into the policies, regulations, and administrative practices.
- Allow interns to observe and understand the implementation of standards and policies in practice.
- Provide opportunities for constructive feedback from supervisors and mentors, aiding in the intern's professional development.
- Enable self-assessment and reflection on strengths, areas for improvement, and career aspirations.
- Encourage sensitivity to the needs and backgrounds of different groups, promoting inclusive and equitable industrial practices.

Course Outcomes

CO 1: Demonstrate improved skills.

CO 2: Exhibit increased professional behavior.

CO 3: Apply theoretical knowledge and principles in real-world practices.

CO 4: Develop and utilize assessment tools to evaluate the learning and practices. CO 5: Engage in reflective practice to continually improve their learning and professional growth.

Facilitating the Interns by an Internship Provider.

1020236351	**Internship**	540 Periods	C
PROJECT			12

Orient intern in the new workplace. Give interns an overview of the organization, Explain the intern's duties and introduce him or her to co-workers.

Develop an internship job description with clear deliverables and timeline.

Allow the interns in meetings and provide information, resources, and opportunities for professional development.

The interns have never done this kind of work before, they want to know that their work is measuring up to organizational expectations, hence provide professional guidance and mentoring to the intern.

Daily progress report of Intern is to be evaluated by industry supervisor. examine what the intern has produced and make suggestions. Weekly supervision meetings can help to monitor the intern's work.

Duties Responsibilities of the Faculty Mentor

To facilitate the placement of students for the internship

To liaison between the college and the internship provider

To assist the Industrial Training Supervisor during assessment **Instructions to the Interns**

- Students shall report to the internship provider on the 1st day as per the internship schedule.
- Intern is expected to learn about the organization, its structure, product range, market performance, working philosophy etc.
- The interns shall work on live projects assigned by the internship provider.
- The Intern shall record all the activities in the daily log book and get the signature of the concerned training supervisor.
- Intern shall have 100% attendance during internship programme. In case of unavoidable circumstances students may avail leave with prior permission from

1020236351	**Internship**	540 Periods	C
PROJECT			12

the concerned training supervisor of the respective internship provider. However, the maximum leave permitted during internship shall be as per company norms where they are working and intern shall report the leave sanctioned details to their college faculty mentor.

- The interns shall abide all the Rules and Regulations of internship provider ●Intern shall follow all the safety Regulations of internship provider.
- On completion of the internship, the intern shall report to the college and submit the internship certificate mentioning duration of internship, evaluation of interns by internship provider, Student's Diary and Comprehensive Training Report.

Attendance Certification

Every month students have to get their attendance certified by the industrial supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the institution supervisor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Training Reports

The students have to prepare two types of reports: Weekly reports in the form of a diary to be submitted to the concerned staff in-charge of the institution. This will be reviewed while awarding Internal

Industrial Training Diary

Students are required to maintain the record of day-to-day work done. Such a record is called Industrial training Diary. Students have to write this report regularly. All days for the week should be accounted for clearly giving attendance particulars (Presence, absence, Leave, Holidays etc.). The concern of the Industrial supervisor is to periodically check these progress reports.

Comprehensive Training Report

In addition to the diary, students are required to submit a comprehensive report on training with details of the organisation where the training was undergone after attestation by the supervisors.

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PROJECT			12

The comprehensive report should incorporate study of plant/product/process/construction along with intensive in-depth study on any one of the topics such as processes, methods, tooling, construction and equipment, highlighting aspects of quality, productivity and system. The comprehensive report should be completed in the last week of Industrial training.

Any data, drawings etc. should be incorporated with the consent of the Organisation.

Scheme of Evaluation

Internal Assessment

Students should be assessed for 50 Marks by industry supervisor and polytechnic faculty mentor during 8th Week and 15th Week. The total marks (50 + 50) scored shall be converted to 40 marks for the Internal Assessment.

Sl. No.	Description	Marks
A	Punctuality and regularity. (Attendance)	10
B	Level / proficiency of practical skills acquired. Initiative in learning / working at site	10
C	Ability to solve practical problems. Sense of responsibility	10
D	Self expression / communication skills. Interpersonal skills / Human Relation.	10

1020236351	**Internship**	540 Periods	C
PROJECT			12

E	Report and Presentation.	10
Total		50

End Semester Examination - Project Exam

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of internship period (Dec - May). The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	Description	Marks
A	Daily Activity Report.	20
B	Comprehensive report on Internship, Relevant Internship Certificate from the concerned department.	30
C	Presentation by the student at the end of the Internship.	30
D	Viva Voce	20

1020236351	**Internship**	540 Periods	C
PROJECT			12
	Total		100

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

Introduction

The Fellowship in the Diploma in Engineering program is designed to provide aspiring engineers with a comprehensive educational experience that combines theoretical knowledge with practical skills. This fellowship aims to cultivate a new generation of proficient and innovative engineers who are equipped to meet the challenges of a rapidly evolving technological landscape. Participants in this fellowship will benefit from a robust curriculum that covers core engineering principles, advanced technical training, and hands-on projects. The program emphasizes interdisciplinary learning, encouraging fellows to explore various branches of engineering, from mechanical and civil to electrical, electronics & communication and computer engineering. This approach ensures that graduates possess a versatile skill set, ready to adapt to diverse career opportunities in the engineering sector.

In addition to academics, the fellowship offers numerous opportunities for professional development. Fellows will engage with industry experts through seminars, workshops, and internships, gaining valuable insights into real-world applications of their studies. Collaborative projects and research initiatives foster a culture of innovation, critical thinking, and problemsolving, essential attributes for any successful engineer.

By offering this fellowship, participants become part of a vibrant community of learners and professionals dedicated to advancing the field of engineering. The program is committed to supporting the growth and development of each fellow, providing them with the tools and resources needed to excel both academically and professionally.

The Fellowship in the Diploma in Engineering is more than just an educational endeavor; it is a transformative journey that equips aspiring engineers with the knowledge, skills, and experiences necessary to make significant contributions to society and the engineering profession.

Objectives

After completing students will be able to,

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

- Provide fellows with a solid foundation in core engineering principles and advanced technical knowledge across various engineering disciplines.
- Equip fellows with hands-on experience through laboratory work, projects, and internships, ensuring they can apply theoretical knowledge to real-world scenarios.
- Promote interdisciplinary understanding by encouraging exploration and integration of different engineering fields, fostering versatility and adaptability in fellows.
- Encourage innovation and creativity through research projects and collaborative initiatives, enabling fellows to develop new solutions to engineering challenges.
- Facilitate professional growth through workshops, seminars, and interactions with industry experts, preparing fellows for successful careers in engineering.
- Develop critical thinking and problem-solving skills, essential for tackling complex engineering problems and making informed decisions.
- Strengthen connections between academia and industry by providing opportunities for internships, industry visits, and guest lectures from professionals.
- Foster leadership qualities and teamwork skills through group projects and collaborative activities, preparing fellows for leadership roles in their future careers.
- Instill a sense of ethical responsibility and awareness of the social impact of engineering practices, encouraging fellows to contribute positively to society.
- Promote a culture of lifelong learning, encouraging fellows to continually update their knowledge and skills in response to technological advancements and industry trends.
- Prepare fellows to work in a global engineering environment by exposing them to international best practices, standards, and cross-cultural experiences.

Course Outcomes

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

CO 1: Demonstrate a strong understanding of core engineering principles and possess the technical skills necessary to design, analyze, and implement engineering solutions across various disciplines.

CO 2: Apply theoretical knowledge to practical scenarios, effectively solving engineering problems through hands-on projects, laboratory work, and internships.

CO 3: Exhibit the ability to conduct research, develop innovative solutions, and contribute to advancements in engineering through critical thinking and creative approaches to complex challenges.

CO 4: Understand and adhere to professional and ethical standards in engineering practice, demonstrating responsibility, integrity, and a commitment to sustainable and socially responsible engineering.

CO 5: Enhance strong communication skills, both written and verbal, and be capable of working effectively in teams, demonstrating leadership and collaborative abilities in diverse and multidisciplinary environments.

Important points to consider to select the fellowship project.

Selecting the right fellowship project is crucial for maximizing the educational and professional benefits of a Diploma in Engineering program.

- **Relevance to Future Plans**: Choose a project that aligns with your long-term career aspirations and interests. This alignment will ensure that the skills and knowledge you gain will be directly applicable to your desired career path.
- **Industry Relevance**: Consider the current and future relevance of the project within the industry. Opt for projects that address contemporary challenges or emerging trends in engineering.
- **Access to Facilities**: Ensure that the necessary facilities, equipment, and materials are available to successfully complete the project. Lack of resources can hinder the progress and quality of your work.

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PROJECT			12

Mentorship and Guidance: Select a project that offers strong mentorship and support from experienced faculty members or industry professionals. Effective guidance is crucial for navigating complex problems and achieving project objectives.

- **Project Scope**: Assess the scope of the project to ensure it is neither too broad nor too narrow. A well-defined project scope helps in setting clear objectives and achievable milestones.
- **Feasibility**: Evaluate the feasibility of completing the project within the given timeframe and with the available resources. Consider potential challenges and ensure you have a realistic plan to address them.
- **Technical Skills**: Choose a project that allows you to develop and enhance important technical skills relevant to your field of study. Practical experience in using specific tools, technologies, or methodologies can be highly beneficial.
- **Soft Skills**: Consider projects that also offer opportunities to develop soft skills such as teamwork, communication, problem-solving, and project management.
- **Innovative Thinking**: Select a project that encourages creativity and innovative problemsolving. Projects that push the boundaries of traditional engineering approaches can be particularly rewarding.
- **Societal Impact**: Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social good can be highly fulfilling and make a meaningful difference.

Guidelines to select Fellowship

- Ensure the program is accredited by a recognized accrediting body and has a strong reputation for quality education in engineering.
- Ensure it covers core engineering principles that align with your interests and career goals.
- Investigate the qualifications and experience of the faculty mentor. Look for programs with faculty who have strong academic backgrounds, industry experience, and active involvement in research.

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PROJECT			12

- Check if the program provides adequate hands-on training opportunities, such as laboratory work, workshops, and access to modern engineering facilities and equipment.
- Assess the program's connections with industry. Strong partnerships with companies can lead to valuable internship opportunities, industry projects, and exposure to real-world engineering challenges.
- Explore the availability of research opportunities. Participation in research projects can enhance your learning experience and open doors to innovative career paths.
- Look for programs that offer professional development resources, such as workshops, seminars, and networking events with industry professionals and alumni.
- Ensure the program provides robust support services, including academic advising, career counseling, mentorship programs, and assistance with job placement after graduation.
- Consider the cost of the program and available financial aid options, such as scholarships, grants, and fellowships. Evaluate the return on investment in terms of career prospects and potential earnings.
- Research the success of the program's alumni. High employment rates and successful careers of past graduates can indicate the program's effectiveness in preparing students for the engineering field.

Duties Responsibilities of the Faculty Mentor

Each student should have a faculty mentor for the Institute.

- Get the approval from the Chairman Board of Examinations with the recommendations of the HOD/Principal for the topics.
- Provide comprehensive academic advising to help fellows select appropriate specializations, and research projects that align with their interests and career goals.
- Guide fellows through their research projects, offering expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field. Assist fellows in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

Offer career advice and support, helping fellows explore potential career paths, prepare for job searches, and connect with industry professionals and opportunities.

- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.
- Facilitate connections between fellows and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure.
- Ensure fellows have access to necessary resources, including research materials, lab equipment, software, and academic literature.
- Regularly monitor and evaluate the progress of fellows, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging fellows to practice integrity and responsibility in their work.
- Assist with administrative tasks related to the fellowship program, such as preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development of fellows.
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

Instructions to the Fellowship Scholar

- Regularly meet with your faculty mentor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your mentor.
- Develop strong organizational skills. Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.

  Take advantage of opportunities to participate in research projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and seminars that enhance these competencies.

- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.
- Seek internships, co-op programs, or part-time jobs related to your field of study. Realworld experience is invaluable for understanding industry practices and enhancing your employability.
- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

Documents to be submitted by the student to offer fellowship.

- **Completed Application Form**: This is typically the standard form provided by the institution or fellowship program that includes personal information, educational background, and other relevant details.
- **Detailed CV/Resume**: A comprehensive document outlining your educational background, knowledge experience, interest in research experience, publications, presentations, awards, and other relevant achievements if any.
- **Personal Statement**: A document explaining your motivation for applying to the fellowship, your career goals, how the fellowship aligns with those goals, and what you intend to achieve through the program.

  Recommendation Letters: Letters from faculty mentor, employer, or professionals who can attest to your academic abilities, professional skills, and suitability for the fellowship.

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PROJECT			12

Proposal/Description: A detailed proposal or description of the fellowship project or study you plan to undertake during the fellowship. This should include objectives, methodology, expected outcomes, and significance of the project.

- **Enrollment Verification**: Documentation verifying your current acceptance status in the academic institution or industry where the fellowship will be conducted.
- **Funding Information**: Details about any other sources of funding or financial aid you are receiving, if applicable. Some fellowships may also require a budget proposal for the intended use of the fellowship funds.
- **Samples of Work**: Copies of the relevant work that demonstrates your capabilities and accomplishments in your field.
- **Endorsement Letter**: A letter from your current academic institution endorsing your application for the fellowship, if required.
- **Ethical Approval Documents**: If your research involves human subjects or animals, you may need to submit proof of ethical approval from the relevant ethics committee.
- **Additional Documents**: Any other documents requested by the fellowship program required by the institution.

Attendance Certification

Every month students have to get their attendance certified by the supervisor in the prescribed form supplied to them. Students have also to put their signature on the form and submit it to the faculty mentor. Regularity in attendance and submission of report will be duly considered while awarding the Internal Assessment mark.

Rubrics for Fellowship. Review I & II.

Sl. No.	Topics	Description

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

1	Alignment with Objectives	Assess how well the project aligns with the stated objectives and requirements. Determine if the student has addressed the key aspects outlined in the project guidelines.
2	Depth of Research:	Evaluate the depth and thoroughness of the literature review. Assess the student's ability to identify and address gaps in existing research.
3	Clarity of Objectives:	Check if the student has clearly defined and articulated the objectives of the project. Ensure that the objectives are specific, measurable, achievable, relevant, and time-bound (SMART).
4	Methodology and Data Collection:	Evaluate the appropriateness and justification of the research methodology. Assess the methods used for data collection and their relevance to the research questions.
5	Analysis and Interpretation:	Examine the quality of data analysis techniques used. Assess the student's ability to interpret results and draw meaningful conclusions.

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PROJECT			12

6	Project Management:	Evaluate the project management aspects, including adherence to timelines and milestones. Assess the student's ability to plan and execute the project effectively.
7	Documentation and Reporting:	Check the quality of documentation, including code, experimental details, and any other relevant materials. Evaluate the clarity, structure, and coherence of the final report.
8	Originality and Creativity:	Assess the level of originality and creativity demonstrated in the project. Determine if the student has brought a unique perspective or solution to the research problem.
9	Critical Thinking:	Evaluate the student's critical thinking skills in analyzing information and forming conclusions. Assess the ability to evaluate alternative solutions and make informed decisions.
10	Problem-Solving Skills:	Evaluate the student's ability to identify and solve problems encountered during the project. Assess adaptability and resilience in the face of challenges.

INTERNAL MARKS - 40 Marks

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

As per the rubrics each topic should be considered for the Review I and Review II. Equal weightage should be given for all the topics. It should be assessed by a faculty mentor and the industrial professional or research guide.

Review 1 shall be conducted after 8th week and Review 2 shall be conducted after 14th week in the semester. Average marks scored in the reviews shall be considered for the internal assessment of 30 Marks.

Scheme of Evaluation

PART	DESCRIPTION	MARKS
A	Assessment as per the rubrics.	30
B	Attendance	10
Total		**40**

END SEMESTER EXAMINATION - Project Exam

1020236353	**Fellowship**	540 Periods	C
PROJECT			12

Students should be assessed for 100 Marks both by the internal examiner and external examiner appointed by the Chairman Board of Examinations after the completion of fellowship. The marks scored will be converted to 60 marks for the End Semester Examination.

Sl. No.	**Description**	**Marks**
A	Daily Activity Report.	20
B	Comprehensive report of the Fellowship Work.	30
C	Presentation by the student.	30
D	Viva Voce	20
Total		100

1020236374	**In-house Project**	540 Periods	C
PROJECT			12

Introduction

Every student must do one major project in the Final year of their program. Students can do their major project in Industry or R&D Lab or in-house or a combination of any two for the partial fulfillment for the award of Diploma in Engineering.

For the project works, the Department will constitute a three-member faculty committee to monitor the progress of the project and conduct reviews regularly.

If the projects are done in-house, the students must obtain the bonafide certificate for project work from the Project supervisor and Head of the Department, at the end of the semester. Students who have not obtained the bonafide certificate are not permitted to appear for the Project Viva Voce examination.

For the projects carried out in Industry, the students must submit a separate certificate from Industry apart from the regular bonafide certificate mentioned above. For Industry related projects there must be one internal faculty advisor / Supervisor from Industry (External), this is in addition to the regular faculty supervision.

The final examination for project work will be evaluated based on the final report submitted by the project group **of not exceeding four students**, and the viva voce by an external examiner.

Objectives

Academic project work plays a crucial role in the education of Diploma in Engineering students, as it helps them apply theoretical knowledge to practical situations and prepares them for realworld engineering challenges.

- **Integration of Knowledge**: Consolidate and integrate theoretical knowledge acquired in coursework to solve practical engineering problems.
- **Skill Development**: Enhance technical skills related to the specific field of engineering through hands-on experience and application.
- **Problem-Solving Abilities**: Develop critical thinking and problem-solving abilities by addressing complex engineering issues within a defined scope.

1020236374	**In-house Project**	540 Periods	C
PROJECT			12

Project Management: Gain experience in project planning, execution, and management, including setting objectives, timelines, and resource allocation.

- **Teamwork and Collaboration**: Foster teamwork and collaboration by working in multidisciplinary teams to achieve project goals and objectives.
- **Research Skills**: Acquire research skills by conducting literature reviews, gathering relevant data, and applying research methodologies to investigate engineering problems.
- **Innovation and Creativity**: Encourage innovation and creativity in proposing and developing engineering solutions that may be novel or improve upon existing methods.
- **Communication Skills**: Improve communication skills, both oral and written, by presenting project findings, writing technical reports, and effectively conveying ideas to stakeholders.
- **Ethical Considerations**: Consider ethical implications related to engineering practices, including safety, environmental impact, and societal concerns.
- **Professional Development**: Prepare for future professional roles by demonstrating professionalism, initiative, and responsibility throughout the project lifecycle.

Course Outcomes

CO 1: Demonstrate the ability to apply theoretical concepts and principles learned in coursework to solve practical engineering problems encountered during the project. **CO 2:** Develop and enhance technical skills specific to the field of engineering relevant to the project, such as design, analysis, simulation, construction, testing, and implementation.

CO 3: Apply critical thinking and problem-solving skills to identify, analyze, and propose solutions to engineering challenges encountered throughout the project lifecycle. **CO 4:** Acquire project management skills by effectively planning, organizing, and executing project tasks within defined timelines and resource constraints.

CO 5: Improve communication skills through the preparation and delivery of project reports, presentations, and documentation that effectively convey technical information to stakeholders.

Important points to consider to select the In-house project.

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Selecting a project work in Diploma Engineering is a significant decision that can greatly influence your learning experience and future career prospects.

- Choose a project that aligns with your career aspirations and interests within the field of engineering. Consider how the project can contribute to your professional development and future opportunities.
- Ensure the project aligns with your coursework and specialization within the Diploma program. It should complement and build upon the knowledge and skills you have acquired in your studies.
- Evaluate the scope of the project to ensure it is manageable within the given timeframe, resources, and constraints. Avoid projects that are overly ambitious or impractical to complete effectively.
- Assess the availability of resources needed to conduct the project, such as equipment, materials, laboratory facilities, and access to relevant software or tools. Lack of resources can hinder project progress.
- Select a project that genuinely interests and motivates you. A project that captures your curiosity and passion will keep you engaged and committed throughout the project duration.
- Consider the availability and expertise of faculty advisors or industry mentors who can provide guidance and support throughout the project. Effective mentorship is crucial for success.
- Clearly define the learning objectives and expected outcomes of the project. Ensure that the project will help you achieve specific learning goals related to technical skills, problemsolving, and professional development.
- Look for opportunities to propose innovative solutions or explore new methodologies within your project. Projects that encourage creativity can set you apart and enhance your learning experience.

  Consider ethical implications related to the project, such as safety protocols, environmental impact, and compliance with ethical guidelines in research and engineering practices.

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- Evaluate whether the project offers opportunities for collaboration with peers, experts from other disciplines, or industry partners. Interdisciplinary projects can broaden your perspective and enhance your teamwork skills.
- Consider the potential impact of your project on society or the engineering community. Projects that address significant challenges or contribute to social good can be highly fulfilling and make a meaningful difference.

By carefully considering these points, Diploma Engineering students can make informed decisions when selecting project work that not only enhances their academic learning but also prepares them for successful careers in engineering.

Duties Responsibilities of the internal faculty advisor.

Each group should have an internal faculty advisor assigned by the HOD/Principal.

- The in-house project should be approved by the project monitoring committee constituted by the Chairman Board of Examinations.
- The in-house project should be selected in the fifth semester itself. Each in-house project shall have a maximum of four students in the project group.
- Provide comprehensive academic advising to help in the selection of appropriate in-house project that align with their interests and career goals.
- Offer expertise and feedback to ensure rigorous methodology, innovative approaches, and meaningful contributions to the field.
- Assist in developing technical and professional skills through hands-on projects, laboratory work, and practical applications of theoretical knowledge.
- Provide personal mentorship, fostering a supportive relationship that encourages growth, resilience, and a positive academic experience.
- Facilitate connections between students and industry professionals, alumni, and other relevant networks to enhance their professional opportunities and industry exposure. Ensure students have access to necessary resources, including research materials, lab equipment, software, and academic literature.

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- Regularly monitor and evaluate the progress of the in-house project, providing constructive feedback and guidance to help them stay on track and achieve their goals.
- Instill and uphold high ethical and professional standards, encouraging students to practice integrity and responsibility in their work.
- Assist in preparing progress reports, writing recommendation letters, and facilitating grant applications.
- Organize and participate in workshops, seminars, and other educational events that enhance the learning experience and professional development .
- Address any issues or conflicts that arise, providing mediation and support to ensure a positive and productive academic environment.

Instructions to the students.

- Regularly meet with your internal faculty advisor for guidance on academic progress, research projects, and career planning. Be proactive in seeking advice and support from your faculty advisor.
- Use planners, calendars, and task management tools to keep track of assignments, project deadlines, and study schedules. Prioritize tasks to manage your time efficiently.
- Take advantage of opportunities to participate in in-house projects and hands-on activities. These experiences are crucial for applying your theoretical knowledge and gaining practical skills.
- Focus on improving essential professional skills such as communication, teamwork, problem-solving, and leadership. Participate in workshops and seminars that enhance these competencies.
- Actively seek networking opportunities through industry events, seminars, and meetings. Establish connections with peers, alumni, and professionals in your field to build a strong professional network.

  Seek internships, co-op programs, or part-time jobs related to your field of study. Realworld experience is invaluable for understanding industry practices and enhancing your employability.

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- Uphold high ethical standards in all your academic and professional activities. Practice integrity, honesty, and responsibility. Adhere to the ethical guidelines and standards set by your institution and the engineering profession.
- Adopt a mindset of lifelong learning. Stay updated with the latest developments and trends in engineering by reading industry journals, attending conferences, and taking additional courses.

Documents to be submitted by the student for an in-house project.

Submit a printed report of your in-house project work along with the fabrication model / analysis report for the End Semester Examination.

Rubrics for In-House Project Work

Sl. No.	Topics	Description
1	Objectives	Clearly defined and specific objectives outlined. Objectives align with the project's scope and purpose.
2	Literature Review	Thorough review of relevant literature. Identification of gaps and justification for the project's contribution.
3	Research Design and Methodology	Clear explanation of the research design. Appropriateness and justification of chosen research methods.

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4	Project Management	Adherence to project timeline and milestones. Effective organization and planning evident in the project execution.

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5	Documentation	Comprehensive documentation of project details. Clarity and completeness in recording methods, results, and challenges.
6	Presentation Skills	Clear and articulate communication of project findings. Effective use of visuals, if applicable.
7	Analysis and Interpretation	In-depth analysis of data. Clear interpretation of results in the context of research questions.
8	Problem-Solving	Demonstrated ability to identify and address challenges encountered during the project. Innovative solutions considered where applicable.
9	Professionalism and Compliance	Adherence to ethical standards in research. Compliance with project guidelines and requirements.
10	Quality of Work	Overall quality and contribution of the project to the field. Demonstrated effort to produce high-quality work.

SCHEME OF EVALUATION

The mark allocation for Internal and End Semester Viva Voce are as below.

Internal Marks (40 Marks)*		
Review 1 (10 Marks)	Review 2 (15 Marks)	Review 3 (15 marks)

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PROJECT	**In-house Project**	540 Periods	12

Committee: 5 Marks. Supervisor: 5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks	Committee: 7.5 Marks Supervisor: 7.5 Marks

Note: * The rubrics should be followed for the evaluation of the internal marks during reviews. **END SEMESTER EXAMINATION - Project Exam**

The performance of each student in the project group would be evaluated in a viva voce examination conducted by a committee consisting of an external examiner and the project supervisor and an internal examiner.

End Semester (100)#			
Record (20 Marks)	Presentation (20 Marks)	Viva Voce (20 Marks)	Model / Analysis Report (40 Marks)
External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 10 Internal: 5 Supervisor: 5	External: 20 Internal: 10 Supervisor: 10

 # The marks scored will be converted to 60 Marks.