Veermata Jijabai Technological Institute (V.J.T.I)

(Central Technological Institute, Maharashtra State, INDIA)
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Programme Name: Diploma In Mechanical Engineering

Programme Code	**: DME**	**With Effect From Academic Year**	**: 2025-26**
Duration of Programme	**: 6 Semester**	**Duration**	**: 16 Weeks**
Semester	**: Fifth**	**Scheme**	**: R-2023**

Sr No	Course Title	Abbrev-ation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self-Learning (Term Work + Assignment)	Notional Learning Hours /Week		Paper Duration (hrs.)	Theory					Based on LL & TL Practical				Based on Self Learning		Total Marks
						CL	TL	LL					FA-TH (MST)	SA-TH (ESE)		Total		FA - (CA)		SA-PR (PR/OR)		SLA		
													Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
1	INDUSTRIAL TRAINING*	IND	INP	234ME51	-	-	-	-	-	0	4	-	-	-	-	-	-	100	-	100#	-	-	-	200
2	THERMAL POWER ENGINEERING	TPE	DSC	234ME52	-	4	-	2		6	3	3	30	70	28	100	40	25	10	25#	10	-	-	150
3	THEORY OF MACHINES	TOM	AEC	234ME53	-	4	-	2	-	6	3	3	30	70	28	100	40	25	10	25#	10	-	-	150
4	METROLOGY AND QUALITY CONTROL	MQC	DSC	234ME54	-	4	-	2	-	6	3	3	30	70	28	100	40	25	10	25#	10	-	-	150
5	ADVANCED MANUFACURING PRACTICES	AMP	DSC	234ME55	-	3	-	2	-	5	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150
6	ELECTIVE –I	-	DSE	234ME56	-	3	-	2	-	5	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150
7	PROJECT- I	PJT-I	SEC	234ME57	-	-	-	4	-	4	2	-	-	-	-	-	-	50	20	50#	20	-	-	100
Total					-	18	-	14	-	32	20		150	350		500		275		275		-	-	1050

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# Online Examination, @$ Internal Online Examination, * 8 weeks industrial training after 4th Semester. Evaluation of training and reports will be done in 5th semester and the credit for the same will be included in 5th semester mark sheet. The teaching load assigned to a faculty for guiding students in preparation training reports and its evaluations for a batch of students (equivalent to practical batch size) would be 1 hour/week in 5th semester.

Course Category : Discipline Specific Course Core (DSC) : 3, Discipline Specific Elective (DSE) : 1, Intern/Project./Community (INP) :1, Ability Enhancement Course (AEC) : 1

DEPT OF MECHANICAL ENGG. V.J.T.I. Mumbai-19

Curriculum Coordinator **Head Diploma in Mechanical Engineering** **Dean Diploma**

DIPLOMA PROGRAMME	**DIPLOMA IN CIVIL ENGINEERING / DIPLOMA IN ELECTRICAL ENGINEERING / DIPLOMA IN ELECTRONICS ENGINEERING / DIPLOMA IN MECHANICAL ENGINEERING / DIPLOMA IN CHEMICAL ENGINEERING / DIPLOMA IN TEXTILE ENGINEERING**
PROGRAMME CODE	**: DCE / DEE / DELNE / DME / DCHE / DTE**
SEMESTER	**: FIFTH**
COURSE TITLE	**: INDUSTRIAL TRAINING**
COURSE CODE	**: 231CE51 / 232EE51 / 233EX51 / 234ME51 / 235CH51 / 236TE51**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
						FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
CL	TL	LL	Self-learning	CR	PAPER HRS	Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
-	-	-	-	4	-	-	-	-	-	-	100	40	100#	40	-	-	200

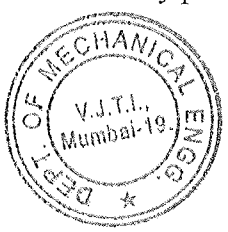
II. RATIONALE

The industry training is aimed to impart employable skills in the respective field to get a job/employment. Students are expected to learn the work practice and environment of the respective industry and develop a report. On the basis of this report the institute departments will evaluate the student performance.

III. COURSE OUTCOMES (COs)

Students will be able to achieve the following COs on completion of course based learning

- CO1 - Gain hands-on experience in applying theoretical concepts to real-world tasks, improving their understanding and problem-solving abilities and readiness for the workforce.
- CO2 - Boosts students' self-confidence and encourages them to pursue ambitious career goals. to earn a livelihood for a better status in society.
- CO3 - Interact with industry professionals during training to build valuable connections for job opportunities.

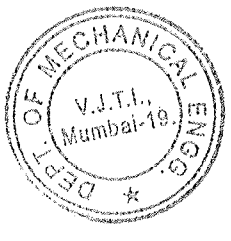


IV. GENERAL GUIDELINES FOR ORGANISING INDUSTRIAL TRAINING

1. **The Industry/organization selected for Industrial training/ internships shall be Government / Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.**
   a) Duration of Training - 8 weeks students engagement time (Min. 28-30 hrs./week)
   b) Period of Time slot: After 4th Semester
   c) Industry area - Engineering Programme Allied industries of large, medium or small-scale, Organization / Govt. / Semi Govt. Sectors.
2. **Role(s) of Training and Placement Office (TPO)- Diploma Programs at the Institute:**

The TPO - Diploma Programs shall be responsible for placing the student for industrial training which shall be a Government / Public Limited/ Private limited / Startup /Centre of Excellence/Skill Centers/Skill Parks etc.

3. **Role(s) of the respective Heads of Department- Diploma / Industrial Training Supervisor(s):**
   a) Concerned Head of Department - Diploma shall appoint a Faculty Industrial Training Coordinator, who can be a permanent / ad-hoc / contractual faculty of the respective department in their departmental faculty meetings before the start of the Mid semester Test for Fourth Semester.
   b) Heads of Department - Diploma shall send the decided names of the Departmental Faculty Industrial Training Coordinator to the TPO - Diploma Programs before the start of the Mid Semester Test of the Fourth Semester.
   c) The Faculty Industrial Training Coordinator shall coordinate with the TPO- Diploma Programs and ensure that all the students of their respective departments are placed by the TPO - Diploma Programs. He/She shall allocate Faculty supervisors to all the students undergoing Industrial Training in their respective departments in consultation with the Diploma Head of Department.
   d) Before the scheduled date as decided by the Diploma Exam Section they shall collect and compile the marks received from the respective Faculty Supervisors for all the students that have undergone the Industrial Training that semester.
   e) The marks shall be submitted to the Diploma Exam Section and the required entries made in the software as per the regular instructions from the Diploma Exam Section. A self-signed copy of the final compiled mark sheet shall be submitted to the TPO - Diploma Programs and the Diploma Head of Department for records.
   f) **Faculty Supervisors** shall coordinate with the allocated industry/organization and monitor the attendance and progress of the students allocated to them. They shall acquire the undertaking from Parents/Guardians (Format 1) and Student (Format 2). They shall ensure to maintain all records like Internship Diary of each student and complete the evaluation for the students allocated to them in consultation with the
   g) **Faculty Industrial Training Coordinator and the Diploma Head of Department**. Maintain the final report submitted by the students at the end of their evaluation. They shall submit the marks to the respective Departmental Faculty Industrial Training Coordinator.



4. Role(s) and Responsibilities of students:

a) Students shall interact with the Faculty Supervisors allocated to them for suggestions on Industrial Training choices of suitable industry, if any. If students have any contact in industry through their parents or relatives then the same may be utilized for securing placement for themselves and their peers through proper documentation through their Faculty Supervisors and TPO Diploma Programs.

b) Students have to obtain the forms/formats duly signed by institutional authorities along with a training letter and submit it to the training officer in the industry on the first day of training.

c) Students must submit the undertaking as provided in Format 1 and to their faculty Supervisors.

d) Students must carry with him/her Identity card issued by the institute during the training period.

e) Students should follow industrial dressing protocols, if any. In absence of specific protocol students must wear appropriate uniform compulsorily as required by the industry.

f) Students will have to get all necessary information from the training officer/mentor at industry regarding schedule of training, rules and regulation of the industry and safety norms to be followed. Students are expected to observe these rules, regulations and procedures strictly.

g) Students must be fully aware that if they disobey any rule of industry or do not follow the discipline then non-disciplinary action will be taken.

h) Students must maintain a weekly diary (Format 3) by noting daily activities undertaken and get it duly signed from Industry mentor or Industrial training in charge.

i) In case students face any major problems in industry such as an accident or any disciplinary issue then they should immediately report the same to their Faculty Supervisor.

Prepare a final report about the training for submission to the department at the time of evaluation, presentation and viva-voce etc. and get it signed by the Faculty Supervisor, Departmental Faculty Industrial Training Coordinator and Diploma Head of Department

5. Typographical guidelines for Industry Training report:

Following is the suggestive format for preparing the training report. Actual report may differ slightly depending upon the nature of industry. The training report may contain the following

a) The training report shall be computer typed (English-British) and printed on A4 size paper.

b) Text Font -Times New Roman (TNR), Size-12 point

c) Subsection heading TNR- 12 point bold normal

d) Section heading TNR- 12 capital bold

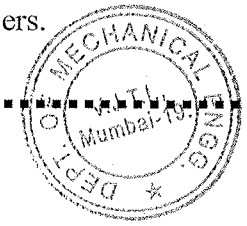
e) Chapter Name/ Topic Name – TNR- 14 Capital

f) All text should be justified. (Settings in the Paragraph)

g) The report must be typed with 1.5 spacing with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.

h) The training report must be Spiral bound. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover [Refer sample sheet (outer cover)]

The training report, the title page should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.



DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH**
COURSE TITLE	**: THERMAL POWER ENGINEERING**
COURSE CODE	**: 234ME52**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL Hrs	TL Hrs	LL Hrs	Self-learning Hrs	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	-	3	3	30	70	28	100	40	25	10	25#	10	-	-	150

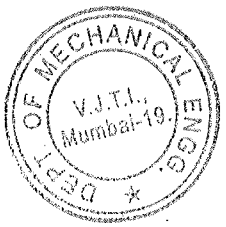
II. RATIONALE

This subject is designed to enhance the basic knowledge about the principles and laws of thermodynamics and its applications. The subject contains the topics of I. C. Engines, Gas Turbines and Steam power plants which are very important power units. It introduces the theoretical frame work, various systems and constructional details of the I. C.Engines, Gas Turbines and Steam power plants from the operation and maintenance point of view.

III. COURSE OUTCOMES (COS):

Students will be able to achieve the following COS on completion of course based learning

1. CO1- To understand the working of different types of I.C.Engines and their applications
2. CO2- To understand the working of different systems used in I.C. Engines
3. CO3-To understand the working of different types of gas turbines and their applications.
4. CO4- To understand the working of Steam power plants and the components involved, e.g. Nozzles, Turbines and Condensers.



IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics		Marks	COS	R Level	U Level	A Level
1	Air standard Cycles:	06	08	1	30%	30%	40%
1.1	Carnot cycle, Otto cycle, Diesel cycle.						
1.2	Derivations of air Standard Efficiencies. Numerical problems.						
2	I. C. Engines	06	06	1	20%	40%	40%
2.1	Classification and applications of I. C. Engines.						
2.2	Working of SI and CI Engines, study of 4-stroke and 2-stroke cycles.						
2.3	Ideal and actual P-V diagrams, valve timing diagrams.						
3	I. C.Engine Systems	06	05	2	40%	40%	20%
3.1	Recent trends in Fuel supply system in SI and CI engines: CRDI, MPFI. Principle of carburettor.						
3.2	Cooling, lubrication and ignition systems in CI and SI engines						
3.3	I. C. engine fuels, fuel ratings.						
3.4	Super charging and turbo charging						
4	I.C. Engine performance and Testing	06	12	2	20%	40%	40%
4.1	Break power, Indicated power, frictional power, Mechanical, Brake thermal, Indicated thermal and Volumetric efficiencies, specific fuel consumption, heat balance sheet.						
5	Gas Turbines	08	04	3	40%	40%	20%
5.1	Introduction to gas turbines, basic cycles, merits and demerits w.r.t. I. C. Engines.						
5.2	Turbojet, Turboprop, Ramjet engines. (No Numerical problems)						

SECTION - II							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
6	Steam Power Cycles	8	12	4	20%	40%	40%
6.1	Carnot cycle, Rankine cycle, Reheat and regeneration cycles.						
6.2	Numerical problems on Rankine Cycle.						
7	Steam Generators	6	04	4	20%	40%	40%
7.1	Classification, Water tube and Fire tube boilers,Cochran and Babcock						

	Wilcox Boilers, Package Boiler, High Pressure Boiler, Benson Boiler.						
7.2	Application of steam in Power generation and Process heating						
8	Steam Nozzles	6	06	4	20%	40%	40%
8.1	Convergent, Convergent-Divergent Nozzles						
8.2	Velocity of steam at exit, nozzle efficiency.						
9	Steam Turbine	6	10	4	20%	50%	30%
9.1	Impulse and reaction turbines,						
9.2	Compounding of Steam turbines						
9.3	Velocity diagrams, determination of power and axial thrust. (single stage only)						
10	Steam Condensers:	6	03	4	20%	40%	40%
10.1	Classification						
10.2	Necessity of steam condensers in power plants						

V. LIST OF PRACTICALS/ASSIGNBMENTS/TUTORIALS

Sr. No.	Practical/Assignment/Tutorial Title	No. of Hours	Relevant COS
1	Identification of components of 4-stroke and 2 stroke cycle engines	2	1
2	Performance test on I. C.Engine	2	1
3	Identification of components of Engine cooling and lubrication systems.	2	2
4	Identification of components of Engine fuel supply systems.	2	2
5	Identification of components of Engine Ignition systems.	2	2
6	Study of Cochran, Babcock Wilcox with the use of cut section models.	2	4
.7	Identification of components of Steam Power Plant and Layout.	2	4
8	Visit to Thermal Power Station.	2	4

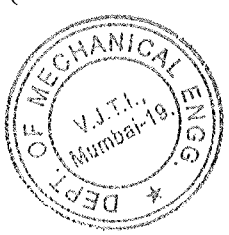
VI. ASSIGNMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

1. Mid semester test
2. Timely practical journal completion
3. Performance in practicals

Summative Assessment (Assessment of Learning)

4. End Term Exam
5. Practical exam



VII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	1	2	-	1	-	-	-	1	1
CO2	1	-	2	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	1	2
CO4	3	2	-	1	-	-	-	2	-
Legends :- High:03, Medium:02,Low:01, No Mapping: -									

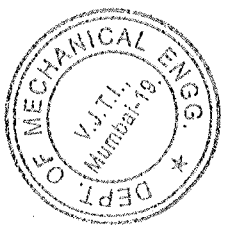
VIII. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No	Author	Title	Publisher
1	R.K.Rajput	Thermal Engineering	Laxmi Publicashions (P) Ltd
2	R.S.Khurmi & J.K.Gupta	Thermal Engineering	S.Chand
3	Mathur & Sharma	Internal combustion Engines	Dhanpatrai publications
4	V.Ganeshan	Internal combustion Engines-	Tata McGraw Hills publications

Curriculum Coordinator

Head of the Department

Dean Diploma



DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH**
COURSE TITLE	**: THEORY OF MACHINES**
COURSE CODE	**: 234ME53**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	-	3	3	30	70	28	100	40	25	10	25#	10	-	-	150

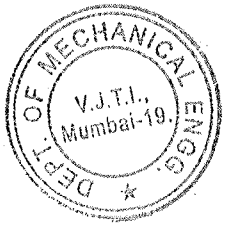
II. RATIONALE

Diploma Engineer should be able to identify and interpret various elements of machines in day-to-day life when they come across various machines in practice. In maintaining various machines, a Diploma Engineer should have sound knowledge of fundamentals of machine and mechanism. TOM subject imparts the kinematics involved indifferent machine elements and mechanisms like I.C. engine, cam-follower, belt-pulley, gear, flywheel etc. This course serves as a prerequisite for other courses such as Machine Design of higher semester etc.

III. COURSE OUTCOMES (CO)

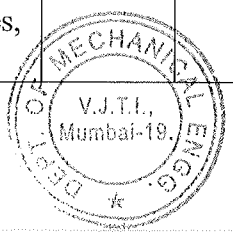
Students will be able to achieve the following CO on completion of course based learning:

- CO1 - Define or state mechanical terminology used in the course.
- CO2 - Interpret working of mechanisms and machine systems- analytically and graphically.
- CO3 - Derive equations related to mechanical systems.
- CO4 - Draw figures of mechanical components as per their function.
- CO5 - Calculate different mechanical parameters considering the given working conditions.



IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1	**Fundamentals and Types of Mechanism**	**2**	**3**				
1.1	Definition of statics, Dynamics, Kinematics, Kinetics, Kinematic link and its types, Kinematic pair and its types, constrained motion and its types			1	50	50	0
1.2	Locked chain, constrained chain and unconstrained chain with equation, Degree of freedom, Kutzbach equation			1	50	50	0
1.3	Mechanism and Inversion of Mechanism, Difference between machine and structure.			1	50	50	0
1.4	Inversions of Four bar chain, Single slider Crank chain, Double Slider Crank Chain			1,4	50	50	0
2	**Velocity and Acceleration in Mechanism**	8	**10**				
2.1	Velocity analysis of simple mechanisms (with maximum six links), by relative velocity and Instantaneous center			2,5	0	80	20
2.2	Acceleration analysis of simple mechanisms (with maximum six links), by relative velocity (Coriolis component to be excluded)			2,5	0	80	20
2.3	Klein's construction to identify velocity and acceleration of different links in single slider crank mechanism (When crank rotates with uniform velocity only).			2,5	0	80	20
3	**Cam and Follower**	4	**8**				
3.1	Types of cams, types of followers, Cam terminology			1	100	0	0
3.2	Cam profiles for following follower motions: constant velocity, S.H.M., constant acceleration & cycloidal motions.			4	0	50	50
4	**Brakes and Dynamometers:**	4	**7**				
4.1	Types of brakes, Internal and external type, single and double shoe brakes, types of band brakes, Determination of braking torque.			4,5	20	40	40



4.2	Types of dynamometers, Construction and working of Rope brake and Prony brake			4,5	50	50	0
5	**Balancing (Graphical method):**	4	**7**				
5.1	Balancing of single and multiple rotating masses in the same plane.			2,5	0	50	50
5.2	Balancing of multiple rotating masses in different transverse planes, static and dynamic balancing.			2,5	0	50	50

SECTION - II							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
6	**Belt Drives, Rope and Chain drives**	6	**8**				
6.1	Type of belts and its material, Selection of belts, types of belt drives. Determination of belt length, velocity ratio, effect of centrifugal tension on power transmission, condition for maximum power to be transmitted, initial tension, determination of width of belt			1,3	20	40	40
6.2	Types of Rope, Advantages and Disadvantages over belt drives. Types of chains and sprockets, Advantages & Disadvantages of chain drive over belt drives (No numerical on Rope & Chain drive).			4,5	50	50	0
7	**Gears and Gear trains**	6	**10**				
7.1	Gear terminology, law of gearing, Types of gears : Spur gears, Helical gears, Bevel gears, Herringbone gears, Worm and worm gears.			4,5	50	50	0
7.2	Types of gear trains, their selection for different applications. Working of a gearbox, Determination of speed ratios in simple and compound gear trains, reverted and epicyclic gear trains.			4,5	0	50	50
8	**Friction in Bearings and Clutches:**	6	**10**				
8.1	Power lost in flat, collared and conical pivot bearings, uniform wear and uniform pressure assumptions, Power transmitting capacity of single and multi-plate clutches, cone clutch.			5	20	40	40

9	**Flywheels and Governors:**	2	**4**				
9.1	Function and application of governors and flywheels, comparison between flywheel and governor.			1,4	50	50	0
9.2	Governor terminology. Working of Proell and Porter Governor			1,4	0	50	20
10	**Vibrations:**	2	**3**				
10.1	Vibrations terminology: period, frequency, amplitude, cycle etc. Mathematical treatment only of single degree of freedom undamped free longitudinal vibrations like spring – mass system, simple pendulum etc.			3,5	50	50	0
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).							

V. LIST OF PRACTICALS/ASSIGNMENT/ SHEETS

Sr. No.	Practical/Assignment	Approx. Hours	CO
	Assignments on following topics		
1	Friction in bearings and clutches	2	3,5
2	Rope and belt drives	2	3,5
3	Brakes and dynamometers	2	3,5
4	Vibrations	2	3,5
5	Gears and gear trains	2	3,5
	Graphical work on following topics:		
6	Velocity and acceleration analysis of mechanisms by relative velocity method.	5	2,5
7	Velocity analysis of mechanisms by instantaneous center method.	5	2,5
8	Types of cam profiles.	5	4
9	Balancing of rotating masses.	5	2,5
	Demonstration of the following items available in the laboratory.		
10	i. Various types of clutches ii. Various types of cams and various types of governors iv. Various types of gears v. Inversions of four bar mechanisms, single slider crank and double slider crank mechanism.	2	NA
11	Miniproject related to different mechanisms.	2	NA

VI. ASSESMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

- Mid semester test
- Timely evaluation of Assignments
- Continuous evaluation of Sheets

Summative Assessment (Assessment of Learning)

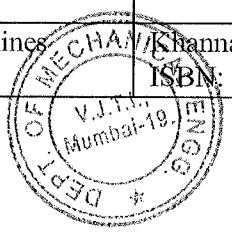
- End Semester Exam
- Oral exam

VII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	03	-	-	-	-	-	-	-	-
CO2	03	02	01	02	-	02	01	02	01
CO3	03	02	-	-	-	02		01	-
CO4	03	-	-	-	01	-	-	-	-
CO5	03	-	01	02	-	02	02	02	01
Legends :- High:03, Medium:02,Low:01, No Mapping: -									

VIII. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS

Textbooks			
Sr.No	**Author**	**Title**	**Publisher with ISBN Number**
1	R.S. Khurmi, J. K. Gupta	Theory of Machines	S. Chand and Company New Delhi, ISBN: 978-8121925242
2	S. S. Rattan	Theory Of Machines	Tata McGraw Hill Edu. New Delhi, 2010, ISBN: 978- 9353166281
3	R. K. Bansal, Brar J. S.	A text book of Theory of Machine	Khanna Book Publishing CO(P) LTD, New Delhi, ISBN: 9788170084181
4	Sadhu Singh	Theory of Machines	Pearson Education ISBN: 978-8131760697
Reference Books			
5	A. Ghosh, A. K. Malik	Theory Of Mechanisms and Machines	Affiliated East west press ISBN: 978-8185938936
6	P. L. Ballaney	Theory Of Machines	Khanna Book Publishing CO(P) LTD, New Delhi, ISBN: 978-8174091222



LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://www.mechanalyzer.com/downloads.html	Mech Analyzer is a free software developed to simulate and analyze the mechanisms
2	https://www.youtube.com/watch?v=oTcC_xXfdrA	Coupling Rod Locomotive
3	https://www.youtube.com/watch?v=8shK6kbu7Xk	Piston cylinder animation showing application of cam and gear train
4	https://www.youtube.com/watch?v=yHHeicPbEzg	Simple Beam Engine
5	https://www.youtube.com/watch?v=yHHeicPbEzg	Knife edge follower and Radial Cam
6	https://www.youtube.com/watch?v=Rib-_ZK8KfE	Roller follower with Radial Cam
7	https://www.youtube.com/watch?v=AODiJYtxuSw	Grear train animation
8	https://www.youtube.com/watch?v=klVYeSlxucU	Types of Belt drives
9	https://www.udemy.com/course/theory-of-machines-determine-de grees-of-freedom-in-a-system/	Degree of freedom
10	https://archive.nptel.ac.in/courses/112/106/112106270/	Online NPTL lectures of Theory of machine
11	https://play.google.com/store/apps/details?id=com.pinjara_im ran5290.Belt_Length_Calculator&hl=en&gl=US&pli=1	Belt length calculator Application (play store app)
12	https://psmotion.com/mechdesigner/feature/cam-design- analysi s	Design of Cam software
13	https://www.vlab.co.in/broad-area-mechanical-engineering	Virtual Lab
14	https://opac.library.iitb.ac.in/	Digital Central Library

Curriculum Coordinator Head of the Department Dean Diploma

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH**
COURSE TITLE	**: METROLOGY AND QUALITY CONTROL**
COURSE CODE	**: 234ME54**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME											
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
4	-	2	-	3	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

A Diploma Engineer must ensure that manufactured components meet design specifications and quality standards. To achieve this, a clear understanding of measurement techniques and quality control principles is essential. The subject Metrology and Quality Control imparts fundamental knowledge about various measuring instruments, standards of measurement, and inspection methods used in the industry. It also emphasizes the importance of quality assurance systems and statistical tools in maintaining and improving product quality. This course enables students to interpret technical tolerances, apply precision measurement techniques, and implement quality control procedures.

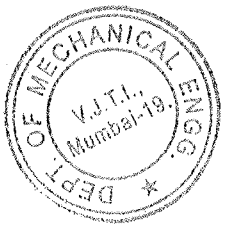
III. Course Outcomes:

Student should be able to

CO1 To describe various instrument and their characteristics.

CO2 To apply knowledge of instruments to used and interpret the data.

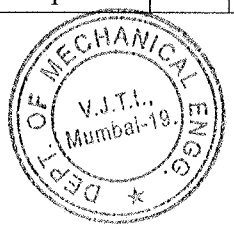
CO3 To apply knowledge for solving problems on limits, fits and tolerances.



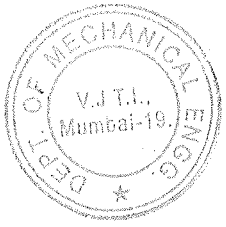
CO4	To solve the type of control chart and acceptance sampling use depending on given data.

IV. Course Content:

SECTION – I								
Unit & Sub-Unit		**Topics/Sub-topics**	**Hrs**	**Marks**	**CO**	**R Level**	**U Level**	**A Level**
1		**Introduction to Metrology**	8	10	1	30	30	
	1.1	**Metrology Basics** Definition of metrology, objectives of metrology, Categories of metrology, Scientific metrology, Industrial metrology, Legal metrology, Need of inspection, **Revision of** --Precision, Accuracy, Sensitivity, Readability, Calibration, Traceability, Reproducibility, Sources of errors, Factors affecting accuracy, Selection of instrument, Precautions while using an instruments for getting higher precision and accuracy. Concept of least count of measuring instruments **(No questions to be set on revision).**						
	1.2	**Standards and Comparators** Definition and introduction to line standard end standard, Wavelength standard and their comparison, Slip gauge and its accessories. Definition, Requirement of good comparator, Classification, use of comparators, Working principle of						



		comparators, Dial indicator, Sigma comparator, Pneumatic comparator- high pressure differential type, Electrical (LVDT), Relative advantages and disadvantages						
2		**Limits, Fits ,Tolerances and Gauges**	6	10	3	20	40	
	2.1	Concept of Limits, Fits, And Tolerances, Selective Assembly, Interchangeability, Hole And Shaft Basis System, Taylor's Principle, Design of Plug, Ring Gauges, IS919-1993 (Limits, Fits & Tolerances, Gauges IS 3477-1973), Study of relation gauges, concept of multigauging and inspection.						
3		**Angular Measurement**	4	7	2	20	40	40
	3.1	Concept, Instruments For Angular Measurements, Working And Use of Universal Bevel Protractor, Sine Bar, Spirit Level, Principle of working of Clinometers, Angle Gauges (With Numerical on Setting of Angle Gauges), Angle dekkor as an angular comparator						
4		**Threads and Gear Metrology**	6	8	2	20	40	40
	4.1	**Screw thread Measurements** ISO grade and fits of thread, Errors in threads, Pitch errors. Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch for internal and external threads. Three wire method, Thread gauge, screw thread micrometer, Working						



		principle of floating carriage micrometer						
	4.2	**Gear Measurement & Testing** Analytical and functional inspection, Measurement of tooth thickness by constant chord method, base tangent method, gear tooth vernier. Errors in gears such as backlash, run out, composite, concentricity. Parkinson gear tester.						

SECTION – II

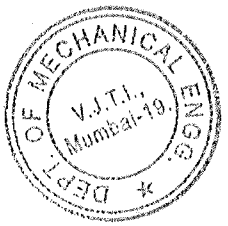
Unit & Sub-Unit		Topics/Sub-topics	Hrs	Marks	CO	R Level	U Level	A Level
5		**Testing Techniques**	6	7	2	0	50	
	5.1	**Measurement of Surface Finish** Primary and secondary texture, Sampling length, Lay, terminology as per IS 3073- 1967, direction of lay, Sources of lay and its significance, CLA, Ra, RMS values and their interpretation, Symbol for designating surface finish on drawing, Various techniques of qualitative analysis						
	5.2	**Machine Tool Testing** Parallelism, Straightness, Squareness, Coaxiallity, roundness, run out, alignment testing of machine tools such as lathe, milling machine and drilling machine as per IS standard procedure. Study of optical flat for flatness testing.						

6		**Quality Control**	8	12	4	30	30	40
	6.1	**Quality :** Definitions, meaning of quality of produce& services, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Concept of reliability, Cost, Quality assurance, Cost of rework & repair, Quality & Inspection, Inspection stages						
	6.2	**Total Quality Management :** Principles and concept of total quantity management. a) Quality Audit: Concept of audit practices, lead assessor certification. b) Six sigma: Statistical meaning, methodology of system Improvement. c) Introduction of ISO 9001-2008.ISO-14000 and TS 16949						
7		**Statistical Quality Control**	10	16	4	20	40	
	7.1	**Statistical Quality Control** Basics of Statistical concepts, Meaning and importance of SQC, Variable and attribute Measurement. control charts – inherent and assignable sources of variation, control charts for variables – X & R charts, control charts for attributes p, np, C charts, process capability of machine, , Cp and Cpk calculations, determination of statistical limits, different possibilities, Rejection area, Statistically capable and incapable processes						

	7.2	**Acceptance Sampling** Concept, Comparison with 100% inspection, Different types of sampling plans, sampling methods, merits and demerits of acceptance sampling. OC Curve						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).								

List of Practicals / Assignments / Tutorials :

Sr. No.	Unit	Practical /Assignment	CO
1	1	Measure various dimensions & dimensional parameters of component using radius gauge, screw pitch gauge, filler gauge, vernier caliper, vernier height gauge, vernier depth gauge, dial type vernier caliper, micrometer, inside micrometer, tube micrometer.	1
2	1	Use of dial indicator as mechanical comparator to inspect given components.	1
3	1	Inspect the given component using high pressure dial type pneumatic comparator.	1
4	2	Set the adjustable snap gauge Go end and No-Go end for a give dimension using slip gauges combination.	3
5	3	Measure an angle of a component using Bevel Protractor and verify it by using Sine bar.	2
6	3	Measure the angle of component with the angle dekkor / autocollimator	2
7	4	Measure the screw thread elements by using screw thread micrometer and the same using optical profile projector or tool maker's microscope.	2
8	4	Measure the gear tooth elements using gear tooth vernier caliper and verify it by using optical profile projector.	2
9	5	Measure the surface roughness of sample turning, milling, shaping, grinding and lapping surfaces by using surface roughness measuring instruments	2
10	5	Testing lathe machine / drill machine for parallelellism, squareness, trueness, alignment test by using test dial indicator.	2



11	6	Draw the frequency histogram, frequency polygon for the samples and calculate mean, mode and median for same.	3
12	7	Draw the normal distribution curve and curve and calculate deviation, variance, range and determine the process capability.	3
13	7	Draw and interpret the control charts (X&R-bar, P-chart and C-chart) for given data.	4

Text Books:

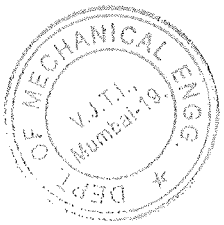
Sr. No.	Author	Title	Publisher and Edition
1	M. Mahajan	Text Book of Metrology	Second Reprint-2010 Dhanpat Rai& Co
2	M. Mahajan	Statistical Quality Control	Dhanpat Rai and Sons-2010

Reference books and Websites:

Sr. No.	Author	Title	Publisher and Edition
1	R. K. Jain	Engineering Metrology	Khanna Publisher, Delhi, 2010
2	I.C. Gupta	A text book of Engineering Metrology	Dhanpat Rai and Sons
3	Douglas C. Montgomery	Statistical Quality Control	Sixth reprint 2011 Wiley India Pvt. Ltd

Curriculum Coordinator **Head** **Dean - Diploma**

Diploma in Mechanical Engineering



DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH**
COURSE TITLE	**: ADVANCED MANUFACTURING PRACTICES**
COURSE CODE	**: 234ME55**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

This course focuses on equipping students with knowledge and working process understand related to modern manufacturing processes and technologies, emphasizing current trends in the field. It aims to provide students with the understanding and abilities needed to apply these advancements in real-world manufacturing contexts.

The course explores various techniques and methods used in contemporary manufacturing, including additive manufacturing, advanced welding, casting and automation and flexible manufacturing.

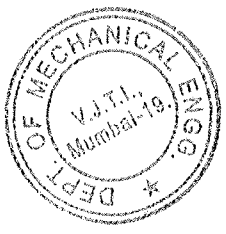
Industry Relevance:

The course is designed to be relevant to the needs of the industry, equipping students with the skills and knowledge sought after by employers

II. COURSE OUTCOMES (COS)

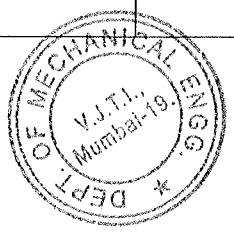
Student should be able to understand the

- CO1: Knowledge and working process understand related to modern manufacturing processes such Welding and various special Casting Process
- CO2: Knowledge and working process understand related to metal forming processes
- CO3: Knowledge and working process understand related to Modern Manufacturing process such as Automation and Flexible Manufacturing System and Rapid prototyping and 3D Printing.



IV. COURSE CONTENTS WITH SPECIFICATION TABLE

Unit & Sub-Unit		Name of the Topic	Hours	Marks	CO	R Level	U Level	A Level
SECTION 1								
01	1.1 1.2 1.3 1.4	**Advanced Welding Processes** Introduction; Working Principle, Advantages, Limitations and Applications of following welding process Electron beam welding (EBW) Ultrasonic welding (USW) Laser beam welding (LBW)	10	12	1	20%	30%	50%
02	2.1 2.2 2.3 2.4 2.5 2.6	**Specific Casting Processes** Introduction; Working Principle, Advantages, Limitations and Applications Continuous casting, Squeeze casting, Vacuum mould casting, Evaporative pattern casting, Ceramic shell casting.	06	10	1	20%	30%	50%
03	3.1 3.2 3.3 3.4 3.5	**Metal Forming Processes** Introduction; Working Principle, Advantages, Limitations and Applications High energy rate forming (HERF) process Explosive forming, Electro-hydraulic forming Electro-magnetic forming	08	13	2	20%	30%	50%
SECTION II								
04	4.1 4.2	**Automation** Importance of Industrial automation in the Indian manufacturing Industry Challenges and Limitations of industrial automations	10	13	3	20%	30%	50%



	4.3 4.4 4.5 4.6	Define, need of automation, Types of automation Fixed, Programmable and Flexible Advantages, limitations and applications of automation Transfer Machines: Types and working of transfer machines						
05	5.1 5.2 5.3 5.4 5.5	**Flexible Manufacturing System** Introduction, Concept, definition and requirement of FMS Types of FMS Single Machine Cell, FMS Cell and FMS Layouts of FMS Line, Loop, Rectangular, Ladder and Open field Advantages, limitations and applications of FMS.	08	12	3	20%	30%	50%
06	6.1 6.2 6.3	**Additive Manufacturing** Define, types and need of AM. Introduction to Rapid Prototyping Technology and 3 - D Printing Types, Advantages, Limitations and Applications	06	10	3	20%	30%	50%
Legends: R- Remember, U – Understand, A – Apply								

V. LIST OF SUGGESTED PRACTICAL'S / ASSIGNMENTS / TUTORIALS:

Following are the suggested sample list of assignment/practicals, which the teacher can use to assign the students.

Sr. No.	Unit	Practical /Assignment	CO
1	1	Assignment on Advance welding Process	1
2	2	Assignment on Advance casting process	1
3	3	Assignment on Advanced Metal Forming Processes	2

4	4	Assignment on Automation and transfer machines	3
5	5	Assignment on Flexible Manufacturing System	3
6	6	Assignment on Rapid Prototyping Technology and 3D Printing	3
7	-	Industrial visit to understand the working of modern manufacturing process and write a report individually on visit.	1-3

VII. ASSESMENTS METHODOLOGIES /TOOLS

Formative assessment (Assessment for Learning)

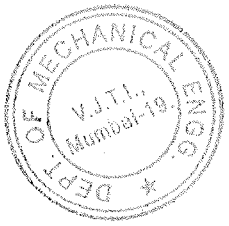
- One midterm test of 30 marks will be conducted and test marks will be considered.

Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

VIII. SUGGESTED COS-POS AND COS-PSOS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	1	-	2	3	2	2	2	2	1
CO2	1	-	2	1	2	1	2	1	2
CO3	1	1	2	2	2	2	2	1	1
Legends :- High:03, Medium:02,Low:01, No Mapping: -									



IX. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No.	Author	Title	Publisher and Edition
1	V. K. Jain	Advanced Machining Processes	Allied Publishers, 2009
2	B.S. Raghuwanshi	Workshop Technology	Dhanpat Rai and sons, New Delhi, 9 th Edition, 2002
3	P.C. Sharma	Production Technology	S. Chand Publications, third edition, 2009
4	William W Luggen	Flexible Manufacturing System	Prentice Hall of Inc New Jersey, 1991
5	Website	https://nptel.ac.in/courses/	

Curriculum Coordinator Head of the Department Dean Diploma

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH**
COURSE TITLE	**: PROJECT I**
COURSE CODE	**: 234ME57**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
						Theory					Based on LL & TL				Based on Self-learning		
											Practical						
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		FA-PR (CA)		SA-PR (PR/OR)		SLA		TOTAL MARKS
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
-	-	4	-	2	-	-	-	-	-	-	50	20	50#	20	-	-	100

III. Course Objectives:

1. To apply the knowledge of basic engineering into practical application.
2. To work on the machines independently.
3. To learn to work in a team so that the students understand the work culture of an organization.

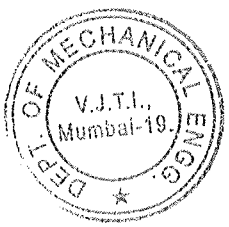
IV.Course Outcomes:

Student should be able to

CO1: Work on machines with responsibility

CO2: Application of theoretical knowledge into practical skills

CO3: Should be able to generate ideas & express the same



V. Introduction:

A project is an inquiry, conducted personally by a trainee(s) who is responsible for using a variety of methods (e.g. analysis, interpretation, planning etc) to undertake a task or study a subject (knowledge or skill or attitude) and to write a report, or solve a problem etc, in line with the objectives of the project. A project can also be termed as an open-ended assignment, the outcome of which is not known at inception and whose progress depends mostly on the intelligence, skills, creativity and energy of the students.

The project work exposes the students to real life problems and introduces them to the procedures and practices used in industry. The project work also helps the students to gain confidence in tackling problems on their own. The project work is needed to strengthen and supplement the learning experience of students. Project-based instruction is an authentic instructional model or strategy in which students plan, implement, and evaluate projects that have real-world applications beyond the classroom. Learning activities that are interdisciplinary, long term, and student centered are emphasized, rather than short, isolated lessons. Most important, students find projects fun, motivating, and challenging because they play an active role in choosing the project and in the entire planning process. Teachers are increasingly working with students who have a wide range of abilities, come from various backgrounds. Institutes are seeking ways to respond to the needs of these students. Project-based instruction provides one way to introduce a wider range of learning opportunities into the classroom. It can engage students from diverse backgrounds because students can choose topics that are related to their own experiences, as well as allow them to use individual learning styles.

VI.Course Content:

Unit & Sub-Unit		Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
1		Performance criteria						
	1.1	Selection of project assignment	10	5	2	30	30	40

	1.2	Planning and execution of considerations	10	10	2			
	1.3	Quality of performance	10	5	1			
	1.4	Providing solution of the problems or production of final product	10	5	3			
2		Sense of responsibility	6	5	1			
	2.1	Self-expression communication skills coil Interpersonal skills/human relations/Viva voce	6	10	2			
	2.2	Report writing skills.	10	5	3			
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).								

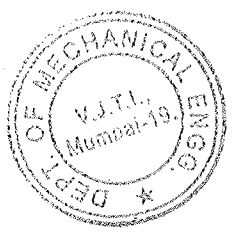
Notes: *This specification table shall be treated as a general guideline and actual distribution of marks may slightly vary from table. But the questions from each topic should be asked as per marks weightage. Numerical questions are to be asked only if specified.*

Important Notes. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria. The criteria for evaluation of the students have been worked out for 50 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination

The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students' performance as per the above criteria. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards. The teachers are free to evolve another criteria of assessment, depending upon the type of project work. It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial/field organization in such an exhibition.

Curriculum Coordinator **Head Mechanical Engineering** **Dean - Diploma**

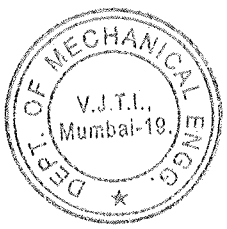
DEPT. OF MECHANICAL ENGG. V.J.T.I. Mumbai-19.


DEPT. OF MECHANICAL ENGG.
V.J.T.I.,
Mumbai-19.

LIST OF THIRD YEAR ELECTIVE SUBJECTS R-2023

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	
COURSE CODE	

SR. NO.	COURSE TITLE
1	Alternate Energy Systems
2	Automobile Engineering
3	CAD/CAM
4	Emerging Trends in Mechanical Engineering
5	Power Plant Engineering
6	Robotics and Automation
7	Tool Engineering
8	Industrial Fluid Power



DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: ALTERNATE ENERGY SYSTEMS**
COURSE CODE	**: 234MEE1**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

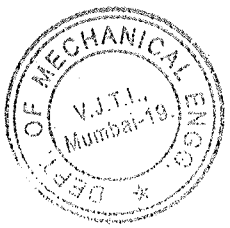
II. RATIONALE

Electrical energy is an important aspect in all sectors of any country's development and economy. The energy crisis is mainly caused due to increased population, excess utilization of conventional sources, enhanced living standard and life style of people. The conventional sources of energy are insufficient to meet these demands. Hence, use of alternate energy sources is increasing day by day for energy generation. The diploma engineers are expected to understand the different types of alternate energy sources and basics of energy conversion, conservation and energy audit. It is also essential to know the applications of non conventional energy sources.

III. COURSE OUTCOMES (COS)

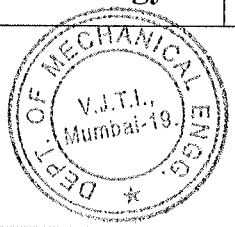
Students will be able to achieve the following COS on completion of course based learning:

- CO1 Understand the need and importance of alternate energy sources.
- CO2 Learn working principle of different direct solar energy conversion methods.
- CO3 Study functioning of various indirect solar energy conversion systems.
- CO4 Utilize different methods for conversion and conservation of energy.



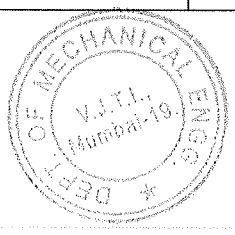
IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1	**Introduction to Energy Sources & Need for Alternative Energy Sources**	**5**	**8**	**1**	**40**	**30**	**30**
1.1	Major sources of energy: Renewable and Non-renewable. Primary and secondary energy sources.						
1.2	Energy Scenario: Energy Crisis, Energy Supply and Demand - understanding a gap.						
1.3	Climate Change Challenge. Need of Alternate energy sources. Prospects of alternate energy sources.						
2	**Solar Energy**	**10**	**15**	**2**	**30**	**30**	**40**
2.1	Applications of Solar energy, Principle of conversion of solar energy into heat and electricity. Solar Radiation: Solar Radiations at earth's surface. Instruments used for measuring solar radiation and duration of sunshine day: Pyranometer, Pyrheliometer and sunshine Recorder. Solar Radiation Geometry: Declination, hour angle, altitude angle, incident angle, zenith angle, solar azimuth angle.						
2.2	Solar Thermal Technology (STT): Construction and working of typical flat plate collector and solar concentrating collectors and their applications, advantages and limitations. Space heating and cooling. Solar distillation, solar cooking and drying. Solar pumping and Green House.						
2.3	Solar Photovoltaic Technology (SPT): Definition of solar/PV cell with its working, PV module and different types of PV modules with efficiencies. Applications of Solar Photovoltaic Technology.						
3	**Bio Mass and Ocean Energy**	**9**	**12**	**3**	**30**	**30**	**40**



3.1	**Bio Mass Energy**						
3.11	Introduction to Biomass energy & its resources, Biomass conversion processes.						
3.1	Construction and working of Biomass Gasification plant and Biogas plant. Introduction to conversion of biomass to Bio-Ethanol and Bio-Diesel production.						
3.2	**Ocean Energy**						
3.21	Ocean Thermal Energy Conversion (OTEC): Construction and working of closed and open Rankine cycle OTEC systems.						
3.22	Tidal Energy: Introduction to tidal energy, Principle of tiadal electric power generation system.						
3.23	Wave energy: Introduction and different devices for wave energy conversion. Construction and working of Oscillating water column (OWC) system and Pelamis system.						

SECTION - II							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
4	**Wind Energy**	**6**	**9**	**3**	**30**	**40**	**30**
4.1	Basic Principle of wind energy conversion: Power in wind, Available wind power formulation, Power coefficient and Maximum power.						
4.2	Main considerations in selecting a site for wind energy conversion system (WECS).						
4.3	Advantages and limitations of WECS.						
4.4	Introduction and working of wind energy conversion system (WECS).						
4.5	Main applications of wind energy: Power generation and pumping.						
5	**Hydrogen Energy**	**6**	**8**	**3**	**30**	**40**	**30**

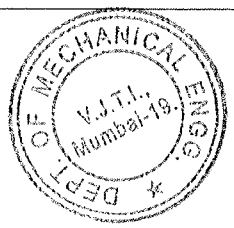


5.1	Properties of hydrogen. Hydrogena Source of renewable energy.						
5.2	Sources of hydrogen, Production of hydrogen.						
5.3	Storage and transportation of hydrogen.						
5.4	Applications of hydrogen.						
6	**Energy Conservation and Management**	**12**	**18**	**4**	**20**	**40**	**40**
6.1	Need and importance of energy conservation and management.						
6.2	Concept of Payback period, Return on investment (ROI), Life cycle cost, Sankey diagrams.						
6.3	Distribution of energy consumption, Need for energy conservation, Methods of energy conservation: Cogeneration and Combined cycle system.						
6.4	Concept of energy management, study of different energy management techniques: Analysis of input, reuse, recycling and reclamation of waste and energy education.						
6.5	Energy audit and its benefits. Different steps involved in energy audit.						
6.6	Distribution of energy consumption, Need for energy conservation, Methods of energy conservation: Cogeneration and Combined cycle system.						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).

V. LIST OF PRACTICALS/ASSIGNBMENTS/TUTORIALS

Sr. No.	Practicals /Assignments	CO
1	Collect information about global and Indian energy market from web sites and prepare report.	1
2	To demonstrate and measure global and diffuse solar radiations on horizontal surface by using Pyranometer.	2



3	Visit to any Solar water heating plant and write report about collector layout, piping's/fittings and measurement, method of manufacturing, cost and performance of the system.	2
4	Visit to I.I.T.B. Mumbai to demonstrate working of solar paraboloid concentrating collector, box type solar cooker, paraboloid concentrating cooker, solar still, solar pump and prepare report of the visit.	2
5	Visit to V.J.T.I. Mumbai PV module assisted power plant and prepare report regarding plant layout with cabling/wiring and measurement of voltage and current by using different energy instruments, method of manufacturing, cost and performance of the system.	2
6	Writing a report on plant structural details and components by visits to a biogas plant or biomass gasification facility.	3
7	Collect information about different tidal power plants from web site sand prepare report.	3
8	Collect information about construction and working of windmill or to visit a nearest wind farm and write a report.	3
9	Practical study of energy audit instruments used for measurement of electric energy, temperature, flow, exhaust gas analysis etc.	4

VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

All Practicals /Assignments will be assigned in groups of students as mini projects per the scope and presentation followed by submission will be done for all Micro Projects at the end of semester.

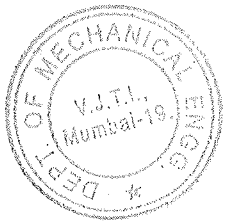
VII. ASSESMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

- Mid semester test
- Timely evolution of mini projects
- Performance in presentation of mini projects

Summative Assessment (Assessment of Learning)

- End Term Exam
- Oral exam



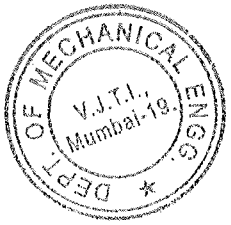
VIII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	2	3	2	2	3	2	2
CO2	3	2	2	3	2	2	3	2	2
CO3	3	2	2	3	2	2	3	2	2
CO4	3	2	2	3	2	2	3	2	2
Legends :- High:03, Medium:02,Low:01, No Mapping: -									

IX. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No.	Author	Title	Publication
1	S. P. Sukhatme and J.K. Nayak	Solar energy: Principles of Thermal Collection & Storage	Tata McGraw Hill, New Delhi
2	C. S. Solanki	Solar photovoltaic: Fundamentals , Technologies, and Applications	PHI Learning PVT LTD, New Delhi
3	G. D. Rai	Non conventional energy sources	Khanna Publications Delhi
4	B. H. Khan	Non-Conventional Energy Resources	McGraw HillCompanies
5	M. M. El-Wakil	Power Plant Technology	McGraw Hill Companies
6	Arora and Domkundwar	A Course in Power Plant Engineering	Dhanpat Rai and Sons
7	R.K. Rajput	A Text book of Power Plant Engineering	Laxmi publications (P) Ltd

Curriculum Coordinator Head of the Department Dean Diploma



DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: AUTOMOBILE ENGINEERING**
COURSE CODE	**: 234MEE2**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

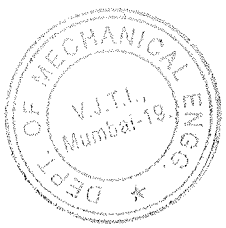
The subject deals with the functioning of an automobile & it's various systems in an automobile. This subject will play very important role in understanding the operation and maintenance of a vehicle and changing technological requirements of the modern world. Automobile engineering, a technology subject, has applications of various subjects taught earlier. All the major global players in automobile sector have launched their products in India. Automotive sector has major employment potential for diploma holders. Automobile servicing in particular offers good job opportunities at village, city & town level. This course in Automobile Engineering will make student understand & apply the knowledge about various system, subsystems & their inter-relationships.

Course Objectives:

1. To understand the working of complete automobile, its engine and various mechanisms in it.
2. To imagine the layout of transmission, control systems, suspension systems and fuel systems in an automobile
3. To understand the working of battery system, charging and lighting in an automobile
4. To have knowledge of maintenance aspects of the automobile and troubleshoot an automobile

Course Outcomes:

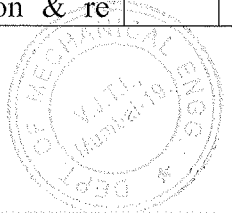
Student should be able to



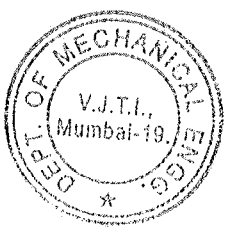
CO1	Understand the functioning of various mechanical systems in an automobile
CO2	Identify various automotive systems & subsystems
CO3	Carry out preventive maintenance & performance testing of vehicle

Course Content:

SECTION - I								
Unit & Sub-Unit		**Topics/Sub-topics**	**Hrs**	**Marks**	**CO**	**R Level**	**U Level**	**A Level**
1		**Introduction to Automobiles**	06	08		40	40	20
	1.1	Classification of automobiles . Introduction to aerodynamic body shapes			1			
	1.2	Vehicle layout & types			1			
	1.3	Body construction- Types & Nomenclature of car body			1			
	1.4	Automobile market in India of on road vehicles, major manufacturers, their products & their collaborations			1			
2		**Automobile transmission**	10	14		40	30	30
	2.1	Clutch- necessity, construction & working of coil spring, diaphragm spring, single plate, multi plate clutches and centrifugal clutches			2			
	2.2	Gear box- tractive effort and tractive resistance, types of G.B, construction & working of sliding mesh G.B, synchromesh G.B, constant mesh G.B. Variator mechanism in scooters & Overdrive, Transfer case.			2			
	2.3	Final drive- necessity, construction & working of propeller shaft & differential.			2			
	2.4	Axle – Type of rear axles, front axles & their applications			2			
3		**Control systems**	08	13		30	30	40
	3.1	Steering system – Requirement of steering system, construction & working of steering linkage, steering gear box-construction & working of rack & pinion & re			2			



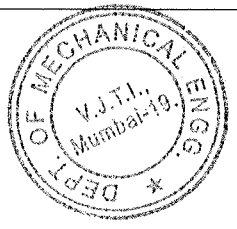
		circulating ball type gearbox. Introduction to power steering, steering geometry, camber, caster, toe-in, toe-out, kingpin inclination & their effects						
	3.2	Brake system , construction & working of hydraulic & pneumatic brakes. Comparison of disc & drum brake			2			
SECTION - II								
Unit & Sub-Unit		**Topics/Sub-topics**	**Hrs**	**Marks**	**CO**	**R Level**	**U Level**	**A Level**
4		**Suspension systems, wheels & tyres**	10	14		40	30	30
	4.1	Necessity & classification of suspension system			1			
	4.2	Working & construction of leaf spring, rigid axle suspension			2			
	4.3	Introduction to air suspension			1			
	4.4	Construction & working of Mcpherson & wishbone, trailing link suspensions			2			
	4.5	Construction & working of telescopic shock absorbers			2			
	4.6	Construction & working of spoked wheel, disc wheel & light alloy cast wheel			2			
	4.7	Types of rims, their construction & working			1			
	4.8	Construction & working & comparison of radial, cross ply & tube type, tubeless tyre, tyre specifications. Factors affecting tyre life			2			
	4.9	Wheel alignment & balancing.			2			
5		**Automobile Electrical Systems & body**	10	14		40	30	30
	5.1	Battery –working, construction & rating of battery.			2			
	5.2	Ignition system-construction & working of electronic & CDI ignition system.			2			
	5.3	Starting system construction & working of starter motor.			2			



	5.4	Charging system- construction & working of alternator			2			
	5.5	Wiring system-harnessing & colour codes			2			
	5.6	Lighting system-head light, tail light, indicator light & their circuits			2			
.	**5.7**	Gauges- construction & working of fuel level gauges, oil gauge & water temperature gauge			2			
6		**Fuel systems** (Including tank, fuel taps, fuel supply pumps, vents, over flow arrangements, level indicators etc)	04	07		40	40	20
	6.1	Fuel supply systems in petrol vehicles			1			
	6.2	Fuel supply systems in diesel vehicles			1			
	6.3	Air supply systems in automobiles with types of air filters(dry & wet type)			1			
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).								

PRACTICALS

Unit & Sub-Unit		**Topics/Sub-topics**	**CO**
	1	Demonstration of single plate coil spring , diaphragm spring type clutch , multiplate clutch & centrifugal clutch	3
	2	Demonstration of sliding mesh, constant mesh & synchromesh gearbox	3
	3	Demonstration of final drive & differential Demonstration of rack & pinion steering gearbox	3
	4	Demonstration of McPherson strut, wish bone type independent and rigid axle vehicles suspension	3
	5	Demonstration of hydraulic brake system with drum & disc brakes	3
	6	Demonstration of battery & charging system	3
	7	Study of LPG/CNG kit retrofitting	3



	8	Visit to four wheeler service station & any automobile manufacturing unit	1

Text Books:

Sr. No.	Author	Title	Publication
1	Mahajan,Naphade, Matani, Ghan	Automobile Manufacturing Systems	Fifth Edition, Vrinda Publications
2	K.K.Jain & R.B Asthana	Automobile Engineering	TATA McGraw Hill Publishing Co
3	S.L.Gavhale,	Automobile Engineering	Fifth Edition 1985, Khanna Publishers
4	G.B.S Narang	Automobile Engineering	Fourth Edition 1985, Khanna Publishers

Reference books:

Sr. No	Author	Title	Publication
1	Crouse & Anglin	Automotive mechanics	Tength Edition, McGraw Hill Book Co
2	Newton Steeds & Garret	Power plant engineering	Tength Edition 1985 Butterworth & co(publishers) Ltd
3	Harbans singh	The Automobile	Thirteenth Edition 2009 S Chand & Co Ltd
4	Joseph Heitner	Automotive Mechanics,	Second Edition, East West Press Pvt Ltd
5	, Dr.N.K.Giri,	Problems in Automobile Mechanics	Third Edition 1986, Khanna Publishers
6	S Srinivasan	Automotive mechanics	Second edition, TATA McGraw Hill publishing Co
7	K.M Gupta,	Automotive Engineering Vol. - I & II	Fourth Edition 2006, Umesh Publications
8	H.M.Sethi	Automotive Technology	First Edition 1991, TATA McGraw Hill Publishing

Curriculum Coordinator **Head** **Dean - Diploma**

Diploma in Mechanical Engineering

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: CAD / CAM**
COURSE CODE	**: 234MEE3**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

 # Importance of CAD/CAM

1. Increased Productivity: CAD/CAM enables designers and manufacturers to create complex products more efficiently and accurately.
2. Improved Accuracy: Computer-aided design and manufacturing reduce human error, ensuring precise and consistent results.
3. Reduced Lead Time: CAD/CAM streamlines the design-to-manufacturing process, reducing time-to-market for new products.
4. Enhanced Collaboration: CAD/CAM facilitates data exchange and collaboration among designers, engineers, and manufacturers.

 # Applications of CAD/CAM

1. Aerospace: Design and manufacture of aircraft and spacecraft components.
2. Automotive: Design and manufacture of vehicle parts and assemblies.
3. Medical Devices: Design and manufacture of medical implants, instruments, and equipment.
4. Product Design: Design and manufacture of consumer products, such as furniture, electronics, and appliances.

 # Benefits of Studying CAD/CAM

1. Career Opportunities: Knowledge of CAD/CAM opens up career opportunities in design, manufacturing, and engineering.
2. Industry Relevance: CAD/CAM is widely used in various industries, making it a valuable skill for professionals.

3. Problem-Solving Skills: Studying CAD/CAM develops problem-solving skills, creativity, and analytical thinking.

By studying CAD/CAM, students can gain a deeper understanding of the design-to-manufacturing process and develop valuable skills for a career in engineering, design, and manufacturing.

III. COURSE OUTCOMES (COS)

Students will be able to achieve the following COS on completion of course based learning

- CO1- To understand basics of CAD/CAM.
- CO2 - To understand concepts of computer graphics and design for effective use of CAD software.
- CO3 - To understand concepts of geometric modelling for effective use of CAD software.
- CO4 - To understand basics of NC/CNC/DNC machines.
- CO5 - To understand construction and programming aspects of CNC machines.

IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	**Topics/Sub-topics**	**Hours**	**Marks**	**COS**	**R Level**	**U Level**	**A Level**
1	**Introduction to CAD/CAM**	**2**	**05**	**1**	**30**	**30**	**40**
1.1	Use of Computers in industrial design and manufacturing						
1.2	Product life cycle and CAD/CAM						
2	**Computer Aided Design**	**4**	**08**	**2**	**30**	**30**	**40**
2.1	The design process, Computers for Design process, concurrent engineering						
2.2	CAD Hardware - basic structure, CPU, Memory, I/O devices, Storage devices and system configuration						
3	**Computer Graphics**	**6**	**10**	**2**	**20**	**40**	**40**
3.1	Scan conversion – Line, circle and 2-D transformations						
3.2	Concepts of windowing, clipping, 3-D transformations, hidden surface, Algorithms						
4	**Geometric Modelling**	**12**	**12**	**3**	**20**	**40**	**40**
4.1	Requirement of geometric modelling, Types of geometric models, Advantages and disadvantages of 3 types of modelling						
4.2	Wireframe Modelling – Mathematical representation, non-parametric,						

	Parametric, Analytical entities, synthetic entities- Hermite, Bezier. B-Spline curves						
4.3	Surface Modelling – Types of surfaces, analytic and synthetic (No numerical treatment)						
4.4	Solid modelling – Geometry and topology, Solid representation schemes- Sweep, B-Rep, CSG, Hybrid, Parametric modelling, feature based modelling						
4.5	Graphics standards- IGES, DXF, STEP						
4.6	Concept of finite element method						

SECTION - II							
Unit & Sub-Unit	**Topics/Sub-topics**	**Hours**	**Marks**	**CO**	**R Level**	**U Level**	**A Level**
5	**Introduction to computer numerical Control**	8	12	4	20	40	40
5.1	Introduction - NC, CNC, DNC, Basic components of NC, NC procedure, The coordinate system in CNC						
5.2	Motion control system - point to point, straight line, Continuous path (Contouring).						
5.3	Advantages and disadvantages of CNC, Application of CNC						
6	**Manual Part Programming**	8	11	4	20	40	40
6.1	Fundamentals, NC – Words, G codes, M codes						
6.2	Programming format, Selection of cutting parameters like speed, feed etc., Machining centre programming, turning centre programming, fixed cycles.						
6.3	Use of subroutines, macros and do loops						
7	**Computer aided Part programming**	8	12	5	30	40	30
7.1	Introduction to APT language, geometry, tool motion, postprocessor, auxiliary statements, Macro						
7.2	CNC Hardware						
7.3	DNC, Adaptive control and Coordinate Measuring Machine						
7.4	Introduction to Rapid Prototype manufacturing method						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms' Revised Taxanomy).

V. LIST OF PRACTICALS/ASSIGNBMENTS/TUTORIALS

Sr. No.	Practical/Assignment/Tutorial Title	No. of Hours	Relevant COS
1	2D Drawing using CAD Software: Create 2D drawings of mechanical components using CAD software (e.g., AutoCAD, SolidWorks).	2	1,2
2	3D Modeling using CAD Software: Create 3D models of mechanical components using CAD software (e.g., SolidWorks, Fusion 360).	2	2,3
3	Assembly Modeling: Create assembly models of mechanical components using CAD software.	2	3,4
4	Dimensioning and Tolerancing: Apply dimensions and tolerances to CAD drawings.	2	4
5	CAM Programming for Turning Operation: Write a CAM program for a turning operation using CAM software (e.g., Mastercam, Solid CAM).	3	5
6	CAM Programming for Milling Operation: Write a CAM program for a milling operation using CAM software.	3	5
7	CNC Machining Simulation: Simulate CNC machining operations using CAM software.	2	4
8	FEA Analysis: Perform stress analysis on a mechanical component using FEA tools (e.g., SolidWorks Simulation, ANSYS).	2	3
9	Design Optimization: Optimize the design of a mechanical component using CAD software and FEA tools.	2	3
10	Reverse Engineering: Reverse engineer a product using CAD software and 3D scanning technology.	2	3
	Tutorials		
1	Introduction to CAD Software: Introduction to CAD software, including basic drawing and editing tools.	1	1
2	Advanced CAD Techniques: Advanced CAD techniques, including 3D modeling, assembly modeling, and dimensioning.	1	2
3	CAM Programming Fundamentals: Fundamentals of CAM programming, including toolpath generation and CNC machining.	1	5

4	FEA Analysis and Design Optimization: FEA analysis and design optimization techniques, including stress analysis and topology optimization.	1	3
5	CNC Machining and Simulation: CNC machining and simulation, including CAM programming and machining simulation.	1	4

VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

Assignments (if any)

1. CAD Software Comparison: Compare and contrast different CAD software (e.g., SolidWorks, AutoCAD, Fusion 360) in terms of features, advantages, and limitations.
2. CAM Programming: Write a CAM program for a simple machining operation (e.g., turning, milling) using a specific CAM software (e.g., Mastercam, SolidCAM).
3. Design and Analysis: Design a mechanical component (e.g., gear, shaft) using CAD software and perform stress analysis using FEA tools (e.g., SolidWorks Simulation, ANSYS).
4. CNC Machining: Create a CNC machining program for a complex part and simulate the machining process using CAM software.

Micro Project (if any)

1. Design and Manufacture a Simple Part: Design a simple part (e.g., bracket, adapter) using CAD software and manufacture it using CNC machining or 3D printing.
2. Optimize a Mechanical Component: Use CAD software and FEA tools to optimize the design of a mechanical component (e.g., reduce weight, increase strength).
3. Develop a CAM Program for a Complex Part: Create a CAM program for a complex part (e.g., mold, die) and simulate the machining process.
4. Reverse Engineer a Product: Reverse engineer a product (e.g., mechanical device, machine component) using CAD software and 3D scanning technology.
5. Design and Simulate a Robotic Arm: Design a robotic arm using CAD software and simulate its motion using kinematic analysis tools.

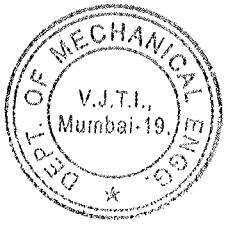
VII. ASSESMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

- Mid semester test
- Timely practical journal completion
- Performance in practical

Summative Assessment (Assessment of Learning)

- End Term Exam
- Practical exam



VIII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	3	3	1	2	3	2	3
CO2	3	2	3	3	1	2	2	3	2
CO3	2	2	3	3	1	2	3	3	3
CO4	3	2	2	3	2	2	2	2	3
CO5	2	3	3	3	1	2	3	3	2
Legends :- High:03, Medium:02,Low:01, No Mapping: 0									

IX. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No	Author	Title	Publisher
1	Groover M. P. & Zimmers	CAD/CAM	Prentice hall of India
2	Groover M. P.	Automation, Production systems and Computer Aided Manufacturing	Prentice hall of India
3	P. N. Rao	CAD/CAM	Tata McGraw-Hill,
4	Sareen & Grewal	CAD/CAM	S. Chand Publications
5	Ibrahim Zeid	CAD/CAM	Tata McGraw-Hill,

Curriculum Coordinator Head of the Department Dean Diploma

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: EMERGING TRENDS IN MECHANICAL ENGINEERING**
COURSE CODE	**: 234MEE4**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

As new technologies rapidly transform the manufacturing industry and related sectors, this course on Emerging Trends in Mechanical Engineering is designed to equip diploma pass outs with the latest knowledge essential for their professional growth. The course covers key areas such as green fuels, autonomous and sustainable maintenance practices, data analytics in manufacturing, and the integration of autonomous vehicles. It also explores the use of drones and autonomous technologies in agriculture. By focusing on these current trends, the course aims to enhance the skills of Mechanical, Automobile, Production, and Mechatronics diploma engineers, preparing them to excel in a rapidly evolving technological environment

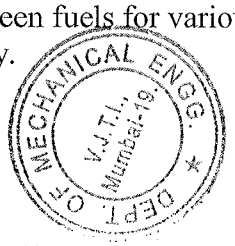
III. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Adopt recent trends in mechanical engineering across various mechanical and allied industries.

IV. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select appropriate green fuels for various applications for considering environmental sustainability.



- CO2 - Apply the principles of Autonomous and Sustainable maintenance practices in industry to improve equipment reliability and efficiency.
- CO3 - Identify the levels of autonomy in various mobility systems.
- CO4 - Use data analytics techniques to improve manufacturing processes and systems.
- CO5 - Utilize automated equipment and technologies for various agricultural applications

V. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1	**Green Fuels**	**6**	**6**	**1**	**20**	**40**	**40**
1.1	Green Fuels: Introduction, Characteristics, Benefits and advantages						
1.2	Classes of Green Fuels: 1st Generation, 2nd Generation, 3rd Generation and 4th Generation Green Fuels						
1.3	Types and Applications of Green Fuels: Biofuel, Hydrogen fuel, Synthetic fuel, Algae fuel, Bio diesel from plants, Applications of Green Fuels in Automobile, Power and Heat, Aerospace sectors.						
2	**Recent trends in Manufacturing systems**	**8**	**15**	**2**	**30**	**30**	**40**
2.1	Big Data in Manufacturing: Introduction, Big Data Characteristics, Benefits						
2.2	Data Analytics in manufacturing: Introduction, Steps in Data Analytics, Types of Data Analytics, Data Analytics techniques, Applications of Big Data analytics in Manufacturing – Preventive maintenance, Product Design, Production Management Automation, Customer Experience, Supply Chain Improvement, Benefits.						
2.3	Data Analytics in Quality Control: Introduction, Applications, Benefits.						
3	**Autonomous Vehicles**	**8**	**14**	**3**	**30**	**30**	**40**
3.1	Autonomy in Mobility Systems (Autonomous Vehicle): Levels,						

	Components, Benefits and Challenges						
3.11	Systems used in Autonomous Vehicles: Advanced Driver Assistance Systems (ADAS) and Full Self-Driving (FSD)						
3.12	Applications of Autonomy in other Mobility Systems: Autonomous Trains, Autonomous Ships, Autonomous Aircrafts (Unmanned Aircraft Systems (UAS)						

SECTION – II							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
4	**Recent Trends in Maintenance**	**10**	**17**	**4**	**30**	**40**	**30**
4.1	Autonomous Maintenance: Concept, Pillars of TPM, Implementation steps, benefits.						
4.2	Sustainable Maintenance: Concept, Importance, Implementation steps, benefits						
4.3	Data Analytics in Predictive Maintenance: Introduction, concept of Computerized Maintenance Management System (CMMS).						
5	**Recent Trends in Agriculture Engineering**	**12**	**18**	**5**	**30**	**30**	**40**
5.1	Automation in Agriculture: Introduction, Automated Farm Equipments - Agri-robots, Harvesting robots, Inspection and Monitoring Agriculture robots, Automatic Seeding and Planting Machine, AI Operated Irrigation Systems, Benefits						
5.2	Autonomous Tractor: Self Driving Tractors, Features and Advantages						
5.3	Agricultural Drones: Soil and Field Analysis, Crop Monitoring, Plantation, Crop Spraying, Advantages of Drones, Government Schemes for Drone Usage						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).

VI. LABORATORY / PRACTICAL / TUTORIAL:

- Task should be assign to students during practical and assignment should be given students on topic topics related with contents during laboratory hours.

VII. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

Two Class test of 30 Marks and Average of two Class test

Summative Assessment (Assessment of Learning)

- End Term Exam
- Practical exam

VIII. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	3	3	1	2	3	2	3
CO2	3	2	3	3	1	2	2	3	2
CO3	2	2	3	3	1	2	3	3	3
CO4	3	2	2	3	2	2	2	2	3
CO5	2	3	3	3	1	2	3	3	2
Legends :- High:03, Medium:02,Low:01, No Mapping: 0									

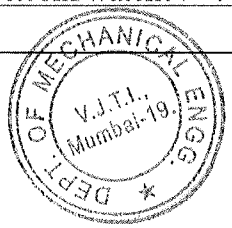
IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Carlos Ricardo Soccol, Satinder Kaur Brar, Craig Faulds, Luiz Pereira Ramos	Green Fuels Technology: Biofuels (Green Energy and Technology)	Springer International Publishing AG; 1st ed. 2016 edition (19 August 2016); 01149344934, ISBN-13: 978-3319302034

2	Fumio Gotoh	Autonomous Maintenance in Seven Steps: Implementing TPM on the Shop Floor	1st Edition, Productivity Press, ISBN- 13: 978-0367199869
3	Samuel Theodore, Daniel Lucky	Autonomous Maintenance	Maintenance Pro, 2023, ISBN-13 ?:979-886417453
4	Matthias Hartwig	Self-driving cars	E-book, 2020, by BMW
5	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos	Autonomous Vehicles Technologies, Regulations, and Societal Impacts	Elsevier,2021, ISBN-13: 978-0323901376
6	Yan Li, Hualiang Shi	Advanced Driver Assistance Systems and Autonomous Vehicles	Springer, Singapore,2022, ISBN-13: 978-9811950520
7	P Suresh, T. Poongodi, B Balamurugan, Meenakshi Sharma	Big Data Analytics in Smart Manufacturing: Principles and Practices	December 14, 2022 by Chapman & Hall, ISBN-13: 978-1032065519
8	Rania I.M. AlmoselhyRania I.M. Almoselhy, Ravindran Chandran, Abisha Juliet Mary S J	Current Trends in Agriculture & Allied Sciences (Volume- 1)	S. P. Publishing, Bhubaneshwar, Odisa,2023, ISBN-13: 978-9359061382
9	Dr. Suman Lata, Mamta J. Patange, Dr. Anand K. Gore, Suchibrata Chamuah and Dr. Chandana Behera	Recent Trends in Agriculture (Volume-5)	Integrated Publications, New Delhi,2023, ISBN-13: 978-9395118644

X. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.engieimpact.com/insights/green-fuels	Green Fuels
2	https://www.youtube.com/watch?v=T_S7Q3Uede4	Green Fuels
3	https://www.researchgate.net/publication/359732622_Green_fuels_concepts_benefits_and_studies_in_Nigeria/link/624c10bec7ab230e99cef13a/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19	Green Fuels
4	https://nitsri.ac.in/Department/Chemical%20Engineering/BRTL12.pdf	Green Fuels
5	https://www.youtube.com/watch?v=4-R5Sh-xSiI&t=5s	Autonomous Maintenance (Total Productive



		Maintenance Series TPM)
6	https://www.youtube.com/watch?v=ZJ6tr1kkRDg	Sustainability in Manufacturing
7	https://www.youtube.com/watch?v=HgF7E5q9sU4&t=1s	An introduction to autonomous vehicles
8	https://www.youtube.com/watch?v=gEy91PGGLR0	Autonomous car / self-driving car
9	https://www.youtube.com/watch?v=ACxTcsxSYvE	Data Analytics in Manufacturing
10	https://www.youtube.com/watch?v=31W0EzcfE74	Big data analytics for manufacturing
11	https://www.youtube.com/watch?v=P2YPG8PO9JU	Agricultural Wonder Drone
12	https://www.youtube.com/watch?v=8-uPCmHX3U0	Agricultural Drones
13	https://www.youtube.com/watch?v=JeU_EYFH1Jk	Artificial intelligence comes to farming in India
14	https://www.youtube.com/watch?v=tSdIgGin_rk	Fully autonomous tractor
15	https://www.skillindiadigital.gov.in/courses/detail/32d86c56-efc6-4c33-9c65-17901e296f8e	Kisan Drone Operator
16	https://www.youtube.com/watch?v=q7tFDw5SAAU	Farming with robots
17	https://www.youtube.com/watch?v=_Dmb1GN52no	Spraying robots

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Curriculum Coordinator | Head of the Department | Dean Diploma

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**:FIFTH/ SIXTH**
COURSE TITLE	**: POWER PLANT ENGINEERING**
COURSE CODE	**: 234MEE5**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

The economic growth of a nation essentially results in growth in the power sector and electric power is the main resource. Various power plants are playing a vital role in the generation of electricity. Most of the power plants are using mechanical engineering equipment and components. Hence, this course will provide the basic knowledge of the components, operation, and maintenance of power plants to the students and also acquaint them with the latest technological advances taking place in the sector. Therefore, this course is designed to cater the requirements of energy efficient devices of power plant

III. COURSE OUTCOMES (COS)

Students will be able to achieve the following COS on completion of course based learning:

- CO1 Understand power scenario & future trends in power sector and analysis of different thermal cycles.
- CO2 Know the working of different conventional power plants and various systems associated with them.
- CO3 Learn the working of different non-conventional power plants and various systems associated with them.
- CO4 Study the waste heat recovery methods and analyze the economics and operational

aspects of different power plants.

IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1	**Introduction to Power Plant**	**5**	**8**	**1**	**40**	**30**	**30**
1.1	Power scenario in India. Types of power plants: Hydro, Nuclear, Thermal and Future Trends in power sector.						
1.2	Analysis of steam cycles: Carnot, Rankine, Reheat cycle, Regenerative cycle, Methods of reheating, Advantages and Disadvantages of reheat cycle.						
1.3	Gas turbine cycles: Closed cycle and open cycle gas turbine.						
2	**Thermal Power Plant**	**10**	**15**	**2**	**30**	**30**	**40**
2.1	Layout of steam power plant, general features of selection of site.						
2.2	High pressure boilers-Construction and working of Sub-Critical and Super-critical boilers.						
2.3	Coal and ash handling system equipment's for in plant handling of coal such as belt conveyor, screw conveyor, bucket elevator, Coal crushing, Pulverized fuel handling system, Ball mill, Pulverized fuel and their advantages, Multi retort stoker, Pulverized fuel burner, Hydraulic and Pneumatic ash handling, Electrostatic precipitator.						
2.4	Boiler Feed water treatment. Environmental aspects of steam power plant: water pollution, air pollution, emission standard and its control.						
3	**Hydraulic & Nuclear Power Plants**	**9**	**12**	**2**	**30**	**30**	**40**
3.1	**Hydraulic Power Plant**						
3.11	Classification, Advantages &						

	Limitations of Hydraulic Power Plant. Selection of Site for Hydraulic power Plants.						
3.12	Layout & Introduction of Essential Features/ Elements of Hydraulic Power Plant.						
3.13	Hydrology: Runoff; Hydrograph; Flow Duration Curve; Rainfall.						
3.2	**Nuclear Power Plant**						
3.21	Fusion and fission reaction. General criteria for selection of site. Elements of nuclear power station, layout, types of nuclear reactors.						
3.22	Nuclear fuels, coolant & moderators. Working of PWR, BWR, CANDU, BREEDER type reactors.						
3.23	Safety precautions and waste disposals						

SECTION - II							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
4	**Gas Turbine Power Plant**	**5**	**9**	**2**	**30**	**40**	**30**
4.1	Components of gas turbine power plants, gas turbine fuels.						
4.2	Comparison of gas turbine plant with diesel and steam power plant.						
4.3	Environmental impact of gas turbine power plant.						
5	**Non-Conventional Power Plants**	**12**	**16**	**3**	**30**	**40**	**30**
5.1	Geothermal power plant: types, economic justification.						
5.2	Tidal power plant: factors affecting suitability of site, working of different tidal power plants, advantages and Disadvantages.						
5.3	Wind power plant: different types, advantages and Disadvantages.						
5.4	Solar Thermal & Photovoltaic power plants.						
6	**Waste Heat Recovery and Environmental Impact of Power Plants**	**7**	**10**	**4**	**20**	**40**	**40**
6.1	Sources of waste heat, Sensible and						

	latent Heat recovery.						
6.2	Uses of waste heat: Agricultural & green house; Waste Heat recovery boilers.						
6.3	Global warming, Greenhouse effect and its control, Carbon foot print.						
6.4	Acid rain: causes, effects and control.						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).

V. LIST OF PRACTICALS/ASSIGNBMENTS/TUTORIALS

Sr. No.	Practicals /Assignments	CO
1	Visit to Thermal power plant/Nuclear power plant & prepare a report.	1
2	Collect information & Technical details of Thermal power plant.	1
3	Collect information & Technical details of Nuclear power plant.	1
4	Collect information & Technical details of hydraulic power plant.	1
5	Collect information & Technical details of Gas Turbine Power Plant.	2
6	Collect information & Technical details of Wind power plant.	2
7	Collect information & Technical details of Solar Thermal and Photovoltaic power plants.	2
8	Assignment on Coal & Ash Handling system.	2
9	Assignment on Waste Heat recovery systems.	3
10	Visit to solar Thermal / Photovoltaic power plants / Hydro power plant/ wind power Plants &prepare a report.	2

VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

All Practicals /Assignments will be assigned in groups of students as mini projects per the scope and presentation followed by submission will be done for all Micro Projects at the end of semester.

VII. ASSESMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

- Mid semester test
- Timely evolution of mini projects
- Performance in presentation of mini projects

Summative Assessment (Assessment of Learning)

- End Term Exam
- Oral exam

VIII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	2	3	2	2	3	2	2
CO2	3	2	2	3	2	2	3	2	2
CO3	3	2	2	3	2	2	3	2	2
CO4	3	2	2	3	2	2	3	2	2
Legends:- High:03, Medium:02,Low:01, No Mapping: -									

IX. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No.	Author	Title	Publication
1	Arora & S. Domkundwar	A course in Power Plant Engineering	Dhanpat Rai And Sons, New Delhi
2	P. K. Nag	Power plant engineering	Tata McGraw Hill, New Delhi
3	S. P. Sukhatme and J.K. Nayak	Solar energy: Principles of Thermal Collection & Storage	Tata McGraw Hill, New Delhi
4	C. S. Solanki	Solar photovoltaic: Fundamentals, Technologies, and Applications	PHI Learning PVT LTD
5	A. Chakrabarti and M.L. Soni	A text book of Power System Engineering	Dhanpat Rai and Co
6	Fredrick T. Mosse.	Power plant engineering	East-West press
7	M. M. EL- Wakil	Power Plant Technology	Tata McGraw Hill, New Delhi
8	R. K. Rajput	Power Plant Engineering	Laxmi Publications, New Delhi
9	G. D. Rai	Non-Conventional Energy	Khanna Publications, Delhi
10	P. C. Sharma	Power Plant Engineering	S. K. Kataria & Sons
11	R. Yadav	Steam And Gas Turbines	Central Publishing House, Allahabad

Curriculum Coordinator Head of the Department Dean Diploma

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: ROBOTICS AND AUTOMATION**
COURSE CODE	**: 234MEE6**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME											
						Theory					Based on LL & TL				Based on Self-learning		TOTAL MARKS
											Practical						
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

The need of today's manufacturing industrial world is based on best quality & precision oriented shorter manufacturing cycle time. To satisfy this need the use of Robotics & Automation is inevitable.

For each of the sectors of Manufacturing Industry identify some of the stages where an industrial robot may be used

a) Automotive

b) Aerospace

c) Space

d) Biotechnology

e) Chemical

f) Electrical and Electronics

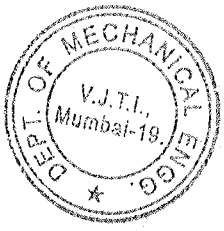
g) Food and Drink processing

Now a day's most of the Industry associated with automated plant like computer integrated manufacturing, Flexible Manufacturing System. Hence Students are also expected to work on in a manufacturing context, in association with the downstream applications.

It is therefore necessary to acquaint the students, through lectures and practical to all the above aspects, with best of the software and hardware available.

III. COURSE OBJECTIVES:

1. To understand concepts of Robotics.



2. To understand constructional aspects for robot.
3. Application of robot in Manufacturing Industry.
4. To know the various automation process available in Industry.

COURSE OUTCOMES (CO)

Students will be able to achieve the following CO on completion of course based learning

CO1 - Understand the history, present status and future / trends of robotics system.

CO2 - Understand the functioning and working of robotics system.

CO3 - Understand the functioning and working of applications of robotics system.

CO4 - Understand concept of automation and its applications in industry.

IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	COs	Hours	R Level	U Level	A Level	Total Marks
Unit - I Robotics: History, Present Status And Future /Trends		01	08	40	40	20	10
1.1	Historical Background Laws of Robotics Robot Definitions.						
1.2	Robotics Systems and Robot Anatomy. Human Systems and Robotics Classifications of Robots.						
1.3	Basic robot motions Technical features such as - work volume, precision and speed of movement, weight carrying capacity.						
Unit - II Robot Drives And Control		02	06	40	30	40	08
2.1	Functions of Drive Systems General Types of Fluids. Introduction to Pneumatic Systems.						
2.2	Electrical Drives & Mechanical Drive Advantages and limitation of various drives						
Unit - III Robot End-Effectors		02	06	40	30	30	10
3.1	Introduction Classification of End-effectors Drive System for Grippers						
3.2	Mechanical Grippers Magnetic Grippers Vacuum Grippers and Adhesive						

	Grippers						
3.3	Hooks, Scoops and Other Miscellaneous Devices						
Unit - IV Vision and Sensors		02	04	40	30	30	07
4.1	Need for Sensing Systems Sensory Devices Types of Sensors Robot Vision Systems						

SECTION - II							
Unit & Sub-Unit	Topics/Sub-topics	**COs**	**Hours**	R Level	U Level	A Level	**Total Marks**
Unit - V Applications Of Robots		03	06	40	30	30	08
5.1	Introduction Capabilities of Robot Robotics Applications Material Handling, Welding, Assembly, Processing Advantages and limitations of Robot						
Unit – VI Concept of automation in industry		04	08	40	30	30	08
6.1	Mechanization and automation, Classification of automation systems. Difference between hard automation and robotic automation.						
Unit – VII Group Technology		04	02	40	40	20	06
7.1	Group Technology Define Part Family, Parts Classification and Coding, Benefits of Group Technology.						
Unit – VIII Flexible manufacturing system		04	08	40	40	20	13
8.1	Introduction, FMS Components, FMS Layout, FMS equipment.						
8.2	FMS application, Introduction to CIM (Computer Integrated Manufacturing System).						
Grand Total			**48**	-	-	-	**70**
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).							

V. LIST OF PRACTICALS/ASSIGNBMENTS/TUTORIALS

Sr. No.	Practical/Assignment/Tutorial Title	No. of Hours	Relevant COS
1	Demonstration of Cartesian/ cylindrical/ spherical robot.	4	1
2	Demonstration of Articulated/ SCARA robot.	4	1
3	Virtual modelling for kinematic and dynamic verification any one robotic structure using suitable software.	4	2
4*	Design and make CAD drawing of two different types of grippers.	4	3
5*	Study of robotic system design.	4	3
6	Setting robot for any one industrial application after industrial visit.	4	4
7*	Case study on any one Automated Industry	4	4

- **Note:** Out of above suggestive '*' marked practicals are mandatory.

VI. ASSESMENTS METHODOLOGIES /TOOLS

Formative assessment (Assessment for Learning)

- One midterm test of 30 marks will be conducted and test marks will be considered.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

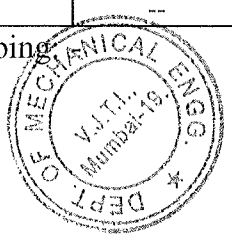
Summative Assessment (Assessment of Learning)

- Pen and Paper Test (Written Test)

VII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	3	2	2	1	--	2	1	--	--
CO2	3	3	3	3	1	--	3	1	--	--
CO3	3	3	2	1	1	--	2	1	--	--
CO4	3	3	2	1	1	--	2	1	--	--

Legends: - High: 03, Medium: 02, Low: 01, No Mapping



VIII. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No	Author	Title	Publisher with ISBN Number
1	Groover M.P. & Zimmers	CAD/CAM	Prentice hall of India
2	Groover M.P	Automation, Production systems and Computer Aided Manufacturing	Prentice hall of India
3	R K Rajput	Robotics and Industrial Automation	S Chand New Delhi

Curriculum Coordinator Head of the Department Dean Diploma

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: TOOL ENGINEERING**
COURSE CODE	**: 234MEE7**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)		SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
												FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	2	2.5	3	30		70	28	100	40	25	10	25#	10	-	-	150

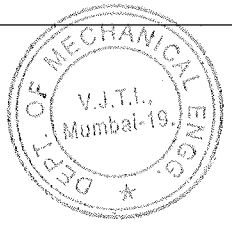
II. RATIONAL

Tools are as basic component for any machining process. The quality and efficiency of any machining operation basically depends upon quality of tools which in turn depends upon the proper shape, size and material of the tools. Productivity and quality of machining operations may further be enhanced by proper and quick mounting of tools and jobs on machines. Jigs and fixture plays an import roll in this process. Therefore this course attempts to develop abilities in students to select a tool of proper size and shape for required machining operation. The design of cutting tools, jigs and fixtures are also dealt with in this course.

III. COURSE OUTCOMES (COs)

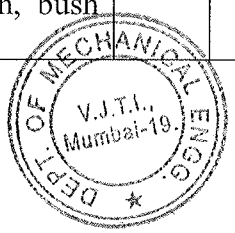
Students will be able to achieve the following COs on completion of course based learning

CO1	Understand & differentiate types of presses & press operation.
CO2	Understand types of dies & their working principles.
CO3	Understand the function and design principles for Jigs.
CO4	Understand the function & design principles for fixtures and Indexing



IV. COURSE CONTENTS WITH SPECIFICATION TABLE

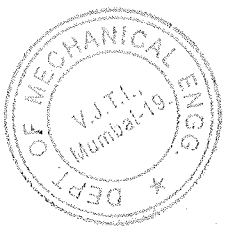
SECTION – I								
Unit & Sub-Unit		**Topics / Sub-topics**	**Hrs**	**Marks**	**CO**	**R Level**	**U Level**	**A Level**
1		**Introduction to press working:**	10	14	1	30	30	40
	1.1	Press working terminology, Basic operations, types of presses-mechanical, hydraulic, pneumatic and their mechanisms, elements of die sets, types of dies simple, compound, progressive, combination and inverted dies, types of punches.						
	1.2	Methods of reduction of shear force, types of strip layouts, types of strippers, types of pilots, stopper, selection of dowel pins and allen screws.						
	1.3	Design of blanking & piercing dies.						
2		**Drawing and Bending Dies**	7	10	1	20	40	40
	2.1	Calculation of blank size, evaluate percentage reduction in each stage ,number of draws, drawing force, blank holding force, press capacity.						
	2.2	Types of Bending dies, developed length calculation, bending force, spring back & methods used to overcome springback.						
3		**Forging Dies**	7	11	2	20	40	40
	3.1	Terminology, Types of Forging Dies, Sketch, Working, Application Force calculation.						
	3.2	Operation - fullering, edging, coining, upsetting, cogging.						
SECTION – II								
Unit & Sub-Unit		**Topics/Sub-topics**	**Hrs**	**Marks**	**CO**	**R Level**	**U Level**	**A Level**
4		**Jigs & Fixture**	10	14	3	20	40	40
	4.1	Introduction, locating & clamping – principle of location, principle of pin location, locating devices, radial or angular location, V–location, bush location.						



	4.2	Design principle for location purpose, principle for clamping purposes, clamping devices,						
	4.3	Design principles common to jigs & fixtures.						
5		**Drilling Jigs**	7	10	3	20	40	40
	5.1	Design principles, drill bushes, design principles for drill bushings.						
	5.2	Types of drilling jigs – Template jig, plate type jig, open type jig, swinging leaf jig, Box type jig, channel type jig. Jig feet.						
6		**Fixtures**	7	11	4	0	50	50
	6.1	Types of fixtures & Application – Overview						
	6.2	Milling fixtures and its types, Design Principles for Milling Fixtures						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxanomy).								

V. LIST OF PRACTICALS/ASSIGNBMENTS/TUTORIALS

Sr. No.	Unit	Practical /Assignment	No. of Hours	CO
1	1	Sketches of Combination Die, Progressive Die, Compound die, Inverted Die, Drawing Die, Bending Die.	2	1
2	1	Drawing of strip layout of simple component and calculation of material utilization factor.	2	1
3	2	Development of blank length for bending operation and single stroke drawing operation.	2	1
4	2	Design of Drawing die	2	2
5	3	Design of Forging die	2	2
6	4	Study of various locating & clamping e, principle of location, principle of pin location, locating devices.	2	3
7	4	Study of Design principles common to jigs & fixtures.	2	3
8	5	Study of Design principles, drill bushes, design principles for drill bushings.	2	3
9	5	Types of drilling jigs.	2	3
10	6	Milling fixture.	2	4



VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

- Study of various elements and functions of jigs and fixture.
- Study of various locating methods for plane, profile and cylinder surfaces.
- Study of different types of bushes and their materials.
- Design of progressive cutting die for simple component and: a. Draw the component. b. Draw scrap strip layout. c. Calculate tonnage and centre of pressure. d. Work out dimensions of punches and die. e. Production drawings of die block, die shoe and stripper plate. f. Draw assembly which include punches, die, die shoe and stripper plate only.
- Design of jig for simple component and: a. Sketch the component. b. Prepare production drawings of all parts of jig (Details). c. Draw assembly.
- Design of fixture for simple component and: a. Sketch the component. b. Prepare production drawings of all parts of jig (Details). c. Draw assembly.

VII. ASSESMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

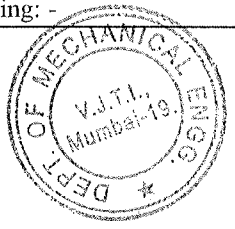
- Mid semester test
- Timely practical journal completion
- Performance in practicals

Summative Assessment (Assessment of Learning)

- End Term Exam
- Practical exam

VIII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)								Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2	PSO- 3
CO1	3	3	2	3	2	2	2	3	2	1
CO2	3	3	2	2	2	1	1	2	1	2
CO3	3	1	2	2	0	1	2	3	2	1
CO4	2	1	2	2	1	2	1	2	1	2
	Legends :- High:03, Medium:02,Low:01, No Mapping: -									



IX. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFRENCE BOOKS/WEBSITES

Sr. No.	Author	Title	Publisher and Edition
1	P. C. Sharma	Production Engineering	S. Chand Publishers
2	Cyril Donaldson	Tool Design	McGraw Hill Education; 4th Edition

Reference books:

Sr. No.	Author	Title	Publisher and Edition
1	Kempster	An introduction to jigs and tool design	English Universities Press
2	ASTME	Fundamentals of tool design	Englewood Cliffs, N.J., Prentice-Hall, 1962.
3	Arshinov	Metal cutting theory and cutting tool design	MIR Publishers.
4	Donald F. Earh and Edward A. Reed.	Techniques of press working sheet metal	Prentice Hall (1965)
5	P. H. Joshi	Press Tool: Design and Construction	S. Chand Publishers

Curriculum Coordinator **Head** **Dean - Diploma**

Diploma in Mechanical Engineering

DEPT. OF MECHANICAL ENGG. V.J.T.I., Mumbai-19.

DIPLOMA PROGRAMME	**: DIPLOMA IN MECHANICAL ENGINEERING**
PROGRAMME CODE	**: DME**
SEMESTER	**: FIFTH/SIXTH**
COURSE TITLE	**: INDUSTRIAL FLUID POWER**
COURSE CODE	**: 234MEE8**

I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	-	2.5	3	30	70	28	100	40	25	10	25#	10	-	-	150

II. RATIONALE

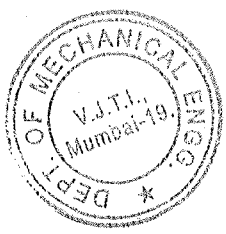
The knowledge of fluid power is essential in many fields of engineering like Manufacturing machinery, automation, in packaging industries.

This course aims to develop the skills that will enable the students to select appropriate hydraulic and pneumatic equipment like pumps, compressors, valves, etc. for a particular application.

III. COURSE OUTCOMES (COS)

Students will be able to achieve the following COS on completion of course-based learning

- CO1- To understand the scope and functioning of hydraulic & pneumatic systems.
- CO2 – To study the working principles of various components used in hydraulic and pneumatic systems
- CO3 - To understand simple hydraulic and pneumatic circuits.
- CO4 –Troubleshooting problems of hydraulic and pneumatic circuits



IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION – I (Hydraulics)							
Unit & Sub-Unit	Topics / Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1	**Introduction to Oil Hydraulic Systems**	3	4	1	30%	30%	40%
1.1	Practical applications of Hydraulic Systems.						
1.2	General layout of Hydraulic Systems.						
1.3	Merits and limitations of Hydraulic Systems.						
1.4	Overview of essential properties of oils used in hydraulic circuits.						
2	**Components of Hydraulic Systems**	11	14	2	20%	40%	40%
2.1	**Pumps –** Construction, principle of working, and symbols of – Reciprocating and Rotary Pumps – Vane Pump, Gear Pump, Screw Pump.						
2.2	**Valves -** Construction, principle of working, and symbols of – Direction Control Valves - Poppet valve, spool valve, 2/2, 3/2, 4/2, 5/2, 4/3, 5/3 D.C. valves, Methods of actuation, Types of different center positions, check valves, pilot operated check valves. Pressure Regulating Valves – pressure relief valve – direct, pilot operated, pressure reducing, pressure unloading, Sequence valves, counter balancing. Flow Control Valves - pressure compensated, non-pressure compensated flow control valve.						
2.3	**Actuators -** Classification of actuators, Construction, working principle, and symbols of Rotary Actuators - Hydraulic motors, Linear Actuators – Cylinders - Single acting, double acting, and their subtypes.						
2.4	**Accessories** – Construction, working principle and symbols of Pipes, Hoses, fittings, Oil filters, Seals and gaskets.						

	Accumulators -Types, construction, working principle, and symbols of all components.						
3	**Hydraulic Circuits**	08	12	3	0	50%	50%
3.1	Hydraulic Circuits – Meter In, Meter Out, and Bleed Off,					0	50% 50%
3.2	Regenerative circuit, Counter Balance Circuit, and Dual Pump unloading circuit.						
3.3	Shaping Machine, and Milling Machine circuits.						
3.4	Sequencing Circuits–Pressure-dependent and Travel dependent.						
4	**Troubleshooting problems of hydraulic circuits.**	2	5	4	0	50%	50%
4.1	Trouble shooting problems - Causes and Remedies of a Hydraulic System and its components – Pumps, Valves, and other accessories.						

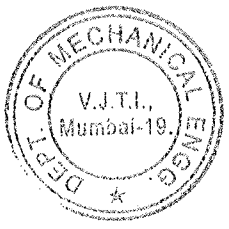
SECTION – II (Pneumatics)

Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
5	**Introduction to Pneumatic Systems**	4	4	1	30%	30%	40%
5.1	Practical applications of Pneumatic Systems.						
5.2	General layout of Pneumatic Systems.						
5.3	Merits and limitations of Pneumatic Systems.						
6	**Components of Pneumatic Systems**	10	15	2	40%	40%	20%
6.1	**Compressor–** Construction, principle of working and symbols of - Reciprocating & Rotary compressors- Introduction.						
6.2	**Control Valves** – Construction, principle of working and symbols of – Pressure regulating valves, Direction Control Valves, Flow Control valves.						
6.3	**Actuators** – Construction, principle of working, and symbols of						

	Rotary Actuators - Air motors, Types, Linear Actuators - Cylinders- single acting, double acting.						
6.4	**Accessories** – Pipes, Hoses, Fittings, FRL unit. (Types, construction, working principle, and symbols of all components).						
7	**Pneumatic Circuits**	10	10	3	0	50%	50%
7.1	Speed control circuits for single acting and double acting cylinders.						
7.2	Pilot operated single acting double acting cylinder (Impulse Circuit).						
7.3	Sequencing circuit of two double acting cylinders using cam, roller operated DC valves.						
7.4	Time Delay Circuit.						
8	**Trouble shooting problems of pneumatic circuits.**						
8.1	Trouble shooting problems - Causes and Remedies of a Pneumatic System and its components – Air Receiver, Air Compressor, Valves, and other accessories.						

V. LIST OF PRACTICALS/ASSIGNMENTS/TUTORIALS

Sr. No.	Practical/Assignment/Tutorial Title	No. of Hours	Relevant COS
1	Compare the performance of oil hydraulic & pneumatic systems, and applications.	2	1
2	Study of various symbols of hydraulic & pneumatic systems.	2	2
3	Study of Pumps and Compressors	2	2
4	Study of different types of Hydraulic and Pneumatic valves.	2	2
5	Prepare simple oil hydraulic circuits.	2	3
6	Demonstration of simple hydraulic circuits	2	3
7	Demonstration of meter in and meter out circuits.	2	3
8	Demonstration of pneumatic circuit for speed control of single acting and double acting cylinders.	2	3
9	Demonstration of sequencing circuits.	2	3
10	Study of trouble shooting procedures of various hydraulic and pneumatic circuits	2	4



VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

Assignments (if any)

- Compare the performance of oil hydraulic & pneumatic systems. and applications.
- Study of various symbols of hydraulic & pneumatic systems.
- Prepare simple oil hydraulic & pneumatic circuits.
- Demonstration of meter in and meter out circuits.

Micro Project (if any)

- Observe different hydraulic machines and their applications in day to day work.
- Observe different fluid power devices and their applications in industries.
- Observe hydraulic and pneumatic devices in the laboratory and study different applications.

VII. ASSESSMENTS METHODOLOGIES /TOOLS

Formative Assessment (Assessment of Learning)

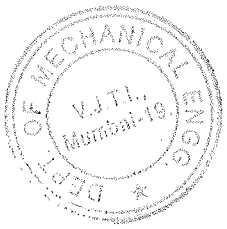
- Mid semester test
- Timely practical journal completion
- Performance in practicals

Summative Assessment (Assessment of Learning)

- End Term Examination
- Practical Examination

VIII. SUGGESTED COS-POS AND COS-PSOS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	-	1	-	2	-	2	2	-
CO2	2	2	1	1	-	-	1	2	-
CO3	2	3	1	1	-	-	1	1	-
CO4	1	3	2	1	2	-	1	2	-
Legends :- High:03, Medium:02,Low:01, No Mapping: -									



IX. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFERENCE BOOKS/WEBSITES

Sr. No	Author	Title	Publisher
1	Majumdar S.R.	Oil Hydraulic system- Principle and maintenance	Tata McGraw Hill
2	Majumdar S.R.	Pneumatics Systems Principles and Maintenance	Tata McGraw Hill
3	Pippenger Hicks	Industrial Hydraulics	McGraw Hill International
4	Stewart	Hydraulics and Pneumatics	Taraporewala Publication
5	Joji B.	Pneumati Controls	Wiley India Publishers.
	Websites	*NEPTEL Mechanical Engineering – Fluid Power Control*	
		https://nptel.ac.in/courses/112106175/	
		https://nptel.ac.in/courses/112102011/2	

Curriculum Coordinator Head of the Department Dean Diploma