Government Polytechnic, Mumbai

Department of Mechanical Engineering

P19 Outcome-based Curriculum

(Sandwich Pattern)

Transform Knowledge into work

Government Polytechnic, Mumbai

Vision

Transform knowledge into work

Mission

We are committed for:

- Quality education for lifelong learning.
- Need based educational programmes through different modes.
- Outcome based curriculum implementation.
- Development and up gradation of standard laboratory practices.
- Promoting entrepreneurial programmes.

We believe in ethical, safety, environment friendly practices and teaching learning innovations.

Mechanical Engineering Department

Vision

Promoting Sustainable development of students

Mission

Department of Mechanical engineering is committed to:

- Need based curriculum revision.
- Provide opportunity for lifelong learning through continuing education.
- Blend the latest technology with conventional practices through experiential learning.
- Enhance industry institute interaction.
- Promote entrepreneurial capabilities.

We believe in high ethical and moral values, sincerity, transparency, and concern for environment.

Department of Mechanical Engineering

PROGRAM OUTCOMES (POS)

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.
3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. **Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Programme Educational Objective statements describe the expected accomplishments of diploma holders during their first few years (three to five years) of exposure in the industrial working environment.

PEO1: Provide solutions to mechanical engineering problems adapting professional ethics in considerations with environmental and societal concerns.

PEO2: Adopt state-of-the-art technologies to work in multidisciplinary environment through self-learning for enhancing technical & entrepreneurial abilities.

PEO3: Pursue sustainable development through life-long learning, upgrade professional skills to work individually as well as an effective team member, in the world of work.

PROGRAM SPECIFIC OUTCOME (PSO'S)

- **PSO1:** To model, analyse, design, and realize physical systems, components or processes in the field of mechanical engineering.
- **PSO2:** Use and maintain mechanical systems / processes in the world of work.

Government Polytechnic Mumbai

Curriculum Philosophy

(P19 Outcome based Curriculum)

(Sandwich Pattern)

Preface

The quality of technical education is dependent on a well-developed curriculum.The curriculum should not focus only on technical contents but it should impart necessary skills that help students to learn how to copewith new challenges. It should prepare them for lifelong learning once they enter the workforce. It is very necessary that the diploma students should be well updated with the latest technological skills and advancements, to meet industrial demands and contribute to nation building. With this thought we have designed outcome based curriculum keeping in view the latest industry trends and market requirements. Outcome based curriculum will be offered to students 2019 onwards. Outcome based curriculum is student centric rather than teacher centric. It is comprising of basic science and engineering having focus on fundamentals, significant discipline level courses and electives. Six month Inplant training is also included in the curriculum to make the student understand industry requirements, have hands on experience and take up project work relative to industry in their final year. These features will allow the students to develop problem solving approach to face the challenges in real life.

In outcome based education, Programme Outcomes, Programme specific outcomes, Course outcomes are defined first and then course contents are designed to achieve these outcomes. During curriculum implementation the teacher will analyze the contents and then develop the learning experiences which will ensure accomplishment of outcome. The industry experts, being main stake holders are actively involved, while designing the curriculum. Outcomes are validated by industry experts, so it will produce industry ready pass outs and increase the employability of students.

Salient features of this curriculum are

- Outcome based curriculum with well defined outcomes for each course
- Incorporation of six month Inplant training
- Built in flexibility to the students in terms of elective courses
- Course on Entrepreneurship and Start-up to encourage entrepreneurial skills
- More weightage for practical's in terms of contact hours to increase skill component
- Student Centered Activity in first, second and third semester to inculcate the habit of physical and mental fitness right at the start
- One MOOCin each semester in order to inculcate self learning capability in students.

- A list of experiments with clear outcomes.

The New Curriculum has been designed to better meet the needs of the industry consideringevolving technological trends and implications for the engineering workforce.This curriculum is also expected to enhance employability skills and develop well trained Diploma Engineers who have theknowledge and the skills to get engineering solutions for real-world problems.

I gratefully acknowledge the time and efforts of all those who contributed to design the curriculum, especially the contributions of chairperson and members of Board of Studies and Programmewise Board of Studies. I acknowledge all the stake holders, aluminies and subject experts.

(Mrs. Swati Deshpande)
Principal
Government Polytechnic Mumbai

Outcome Based Education Philosophy

As the National Board of Accreditation (NBA)is focusing on the adoption of Outcome Based Education (OBE) approach, Government Polytechnic, Mumbai has adopted the OBE approach for design of curriculum P19 to all programmes. NBA adopted Outcome based Model because, OBE is "Student Centric" rather than "Teacher Centric". OBE focuses on the graduate attributes or outcomes after completing an academic programme. Outcome based approach means knowingwhat you want to achieve and then taking the steps to do so.Starting with a clear picture of what is important for students to be able to do and then organizing the curriculum delivery and assessment to make sure learning happens.

Some Benefits of OBE are

1. Satisfying the need of stake holders
2. More specific and coherent curriculum
3. Student centric

Components of the OBE are

1. Outcome based curriculum: What students should be able to do after learning the curriculum?
2. Outcome based Teaching Learning: Prepare and train the students to achieve the outcomes.
3. Outcome based assessment: Measure what the student has achieved? Indentify which outcome has not attained by the students.
4. Remedial measures: Take the remedial measures so that student can achieve that outcome.

Fig1. Outcome Based Education Philosophy

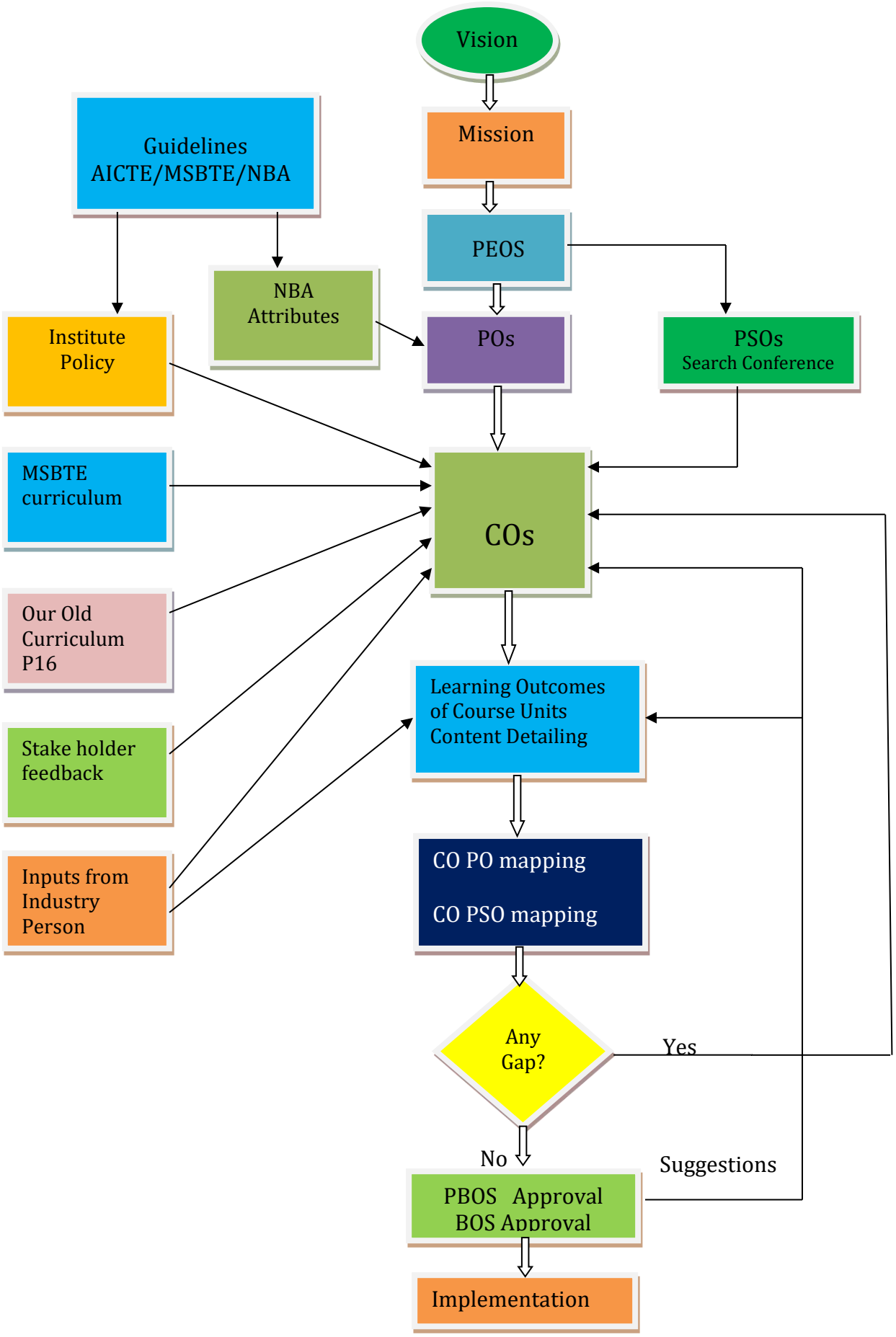

Fig. 2 Curriculum Design Process

Figure 1 shows outcome based education philosophy. Vision and mission statements willbe finalized first, and then each programme will finalize Programme educational objectives (PEOs). Programme outcomes (POs) are given by NBA. Each programme will finalize their Programme Specific Outcomes (PSOs). Then course outcomes (COs) are finalized and then content detailing of each course will be carried out.

Figure 2 shows our curriculum design process/philosophy. Figure is self explanatory. Important steps are given below. Process starts with formulation of vision mission statements of the institute.

1. Formulation of Vision Mission Statements

Vision Mission statements of the institute are finalized using following steps.

- Bottoms up approach
- Involvement all stakeholders
- Discussion, Brain storming sessions among all stake holders
- Gap analysis or SWOT analysis
- Challenges before the institute
- What are the immediate and long term goals

After following these steps vision and mission statements of the institute is finalized as

Institute Vision

Transform Knowledge into Work

Institute Mission

We are committed for

- Quality education for lifelong learning
- Need based educational programmes through different modes.
- Outcome based curriculum implementation
- Development and up gradation of standard laboratory practices
- Promoting entrepreneurial programmes

We believe in ethical, safety, environmental friendly practices and teaching learning innovations.

Once, the vision mission statements are finalized. Using the same procedure vision mission statements of each programmes are finalized.

2. Programme Educational Objectives (PEOs)

The Programme educational objectives of a diploma program are the statements that describe the expected achievements of diploma holders in their career, and also in particular, what they are expected to perform and achieve during the first few years after diploma. The PEOs, may be guided by global and local needs, vision of the Institution, long term goals etc.For defining the PEOs the faculty members of the program have continuously worked with all Stakeholders: Local Employers, Industry, Students and the Alumni

3. Programme Outcomes (POs)

Programme outcomes are given by NBA. They are

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis:** Identify and analyzewell defined engineering problems using codified standard methods**.**
3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. **Engineering tools experimentation and testing:** Apply modern engineering tools and appropriate technique to conduct standard test and measurements.
5. **Engineering practices for society sustainability and environment:** apply appropriate technology in context of society sustainability environment and ethical practices
6. **Project management:**Use Engineering Management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. **Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes

4. Programme Specific Outcomes (PSOs)

These outcomes are specific to a program in addition to NBA defined POs, namely, Civil, Computer, Electrical, Electronics, Mechanical, Information Technology, Instrumentation, Rubber Technology, Leather Technology, and Leather Goods and Footwear technology.

5. Course Outcomes (COs) and Content detailing

"Statements of observable student actions that serve as evidence of the Knowledge, Skills and Attitudes acquired in a course". Each course is designed to meet (about 4 to 6) Course Outcomes

The Course Outcomes are stated in such a way that they can be actually measured. "Blooms Taxonomy" is used for framing course outcomes.

Course Outcome statementsare broken down into two main components:

- **An action word** that identifies the performance to be demonstrated;
- **Learning statement** that specifies what learning will be demonstrated in the performance;

Once the COs are finalized, content detailing of each course is done as per the course outcomes. For content detailing inputs are taken from stake holders, MSBTE curriculum and industry persons.

6. CO-PO and CO-PSO mapping

When all COs are finalized, COs are mapped with POs and PSOs. During mapping if it is found that particular PO or PSO has not been addressed by any CO, then it is considered as gap. To remove this gap, again COs are modified. This process will repeat till all POs and PSOs are mapped by COs.

7. Approval in PBOS and BOS meetings.

After CO-PO and CO-PSO mapping, content detailing is done. Then the curriculum is kept for approval in Programme wise Board of studies (PBOS) meeting. Each programme has its own PBOS committee whose structure is as follows.

Head of Department concerned	Chairman
Two senior Lecturers	Members
One expert from the neighboring institute	Member
Nominee from the board of technical Education	Member

One expert from the local industry	Member
Departmental Curriculum Coordinator	Member Secretary

Suggestions given by PBOS members are incorporated in the curriculum and then it is put in front of Board of studies (BOS). Structure of BOS is as follows.

Representative from Industry	Chairman
Principal	Member
Head of All departments	Member
Local Experts of all programmes	Member
Nominee from the board of technical Education	Member
In charge CDC	Member Secretary

Suggestions given by BOS members are incorporated in the curriculum and the finalized curriculum is then offered to the students.

8. Institute Policies

As per the guidelines given by All India Council of Technical Education (AICTE), Maharashtra State Board of Technical Education (MSBTE), Directorate of Technical Education (DTE) and NBA, Institute policies about curriculum design are decided in the meeting of all Heads of the departments.

Being an autonomous institute, we revise our curriculum after every 4 to 5 years. Earlier it was revised in 2016. Curriculum 2016 was outcome based curriculum. As per instructions received from AICTE and NBA, Outcome based curriculumshould be offered to students,we have offeredOutcome based curriculumin 2016. In 2019, we have conducted search conference in all departments to identify set of skill components that should be developed in students at the end of the diploma programme. Here we got suggestions from industry experts as well as from stakeholders about incorporation of six month Inplant training in the curriculum itself to give awareness about industry culture to students. So in 2019 we revised our curriculum. It is outcome based with six months Inplant training. We got approval from AICTE also. So now all courses are sandwich pattern. This scheme we name as P19 scheme. In 2019 it will be offered to first year and in subsequent years it will be offered to second year and third year. Once the curriculum frame work is finalized at the institute level, as per the demand of the industry, course contents can be

changed at any level without disturbing the frame work. This is necessary to satisfy the present demand of the industry and remove the curricula gaps as per the advancement in technology.

2019curriculum is of 180 credits (215 teaching hours). As per AICTE norms given in APH 2015-16, contact hours per semester should be 525 hours and number of teaching days should be 75 in a semester (7 hours per day i.e. 35 hours per week). Total weeks for teaching are 15. One week will be for unit test exam. Total term will be of 16 week.

So we decided to design 2019 curriculum with 180 credits.

Definition of Credit:

1 Hr. Lecture (L) per week 1 credit

1 Hr. Tutorial (T) per week 1 credit

2 Hours Practical (P) per week 2 credit

All programmes (Civil Engineering, Computer Engineering, Electrical Engineering, Electronics Engineering, Information Technology, Instrumentation, Mechanical Engineering, Rubber Technology, Leather Technology, Leather Goods and Footwear Technology) have incorporatedsix month Inplant training in their curriculum, wherein students will go for Inplant training in the industries during last semester. 20 credits (40 teaching hours per week) are allotted for Inplant training.

Curriculum Framework

Semester wise Credit distribution and Mark distribution is given below.

Curriculum Frame work for All Programmes

Year	**Semester**	**Credits**	**Teaching hours**	**Marks**
First	**First**	30	35	600 to 700
	Second	30	35	600 to 700
Second	**Third**	30	35	600 to 700
	Fourth	35	35	700 to 800
Third	**Fifth**	35	35	700 to 800
	Sixth	20	40	200
Total		180	215	3400 to 3900

Apart from technical courses, in first 3 semesters, 5 teaching hours per week are allotted for Student Center Activities. Breakup of these five hours is as follows.

Library – 1 hr

Sports – 2 hrs

Creative arts – 2 hrs

In order to inculcate self learning capability in students MOOC (Massive Open Online Course) in each semester is incorporated in the curriculum of all programmes.

As per AICTE model curriculum 60% weightage is given for external examination and 40% weightage is given for internal examination as far as theory is considered. For all courses in all programmes 60+20+20 pattern of examination is followed. Two internal progressive assessment tests are conducted for theory courses in a semester having maximum marks 20. End semester examination of 60 Marks is conducted at the end of the semester. Addition of two test marks with end semester examination marks will give total marks out of 100.

After test as well as end term examination bitwise analysis of answer book of each student will be done in order to calculate course outcome attainment. From course attainment, PO and PSO attainment will be calculated. If attainment is not satisfactory remedial measures will be taken by respective department.

For courses, those they are having practical's, Term work is kept, where continuous assessment is made compulsory.

In the sixth semester, students are going for Inplant training. Before going into industry at least he/she should learn basic things required for his/her programme. In order to achieve this, a prerequisite of minimum 100 credits is must for registration of Inplant training. A student will be eligible for registration of Inplant training only when he/she completes minimum 100 credits.

Award of Diploma

For the award of diploma in all programmes, all courses of 5th semester and Inplant training will be considered along with weightage of third and fourth semester courses as shown in following table.

All courses of fifth semester	700 to 800 Marks
Inplant Training	200 Marks
Consolidated marks of third and fourth semester*	200 marks
Total marks	1100 to 1200 Marks

*Consolidated Marks of third and fourth semester – the total marks of third and fourth semesters are converted to 100 marks each. These marks are then added (3rdSem + 4thsem) as 100+100 = 200 marks.

Implementation of MOOC:

In each semester all programmes will offer a MOOC. Programme head should see that this MOOC is freely available to all students; it should not be financial bourdon on students. Sufficient number of lectures/sessions should be available for the course which is offered through MOOC. For 1 credit per week one lecture or one session of 45 minutes to 60 minutes should be available.

For MOOC courses online examination is conducted by service provider for example spoken tutorial. Spoken tutorial will issue certificates also. Programme head should collect certificates of all students semester wise and submit to controller of examination.

As exam is conducted by some other agency, marks are not taken into consideration. They will not reflect in the result. But unless and until student complete certification, credits of MOOC will not be awarded to the students. Without completion of 180 credits diploma will not be awarded.

Student can complete MOOC at any time throughout of this tenure of diploma. Course or exam registration of student in any semester will not be blocked due to incompletion of MOOC. Whenever student completes certification, in that term, in the result of term end examination credits will be allotted.

If a MOOC is performed through NPTEL, course is free but for getting certification, student has to pay extra fees. In such a case, to avoid financial bourdon on students, MCQ based examination of such courses will be conducted by respective departments and certification can be provided by respective department. For certification, passing criteria of 40% should be used.

Course Codes:

Entire curriculum of all Programmes is divided into five levels. These levels and their percentage is given below.

Level1- Science and Humanities (10 to 15%)

Level2- Core Technology (25 to 30%)

Level3- Applied Technology (45 to 50%)

Level4- Diversified Courses (5 to 10%)

Level5- Management courses (3 to 5%)

Course Coding Scheme:-

Course Code abbreviations	**Definitions**
HU	Humanities
SC	Science
MG	Management
CE	Civil
CO	Computer
EC	Electronics
EE	Electrical
IT	Information Technology
IS	Instrumentation
RT	Rubber
LT	Leather Technology
LG	Leather Goods and Footwear
ME	Mechanical Engineering

Course codes are formed as:

First two letters are course code abbreviations. Then two digits "19" refers to 2019 curriculum.

Next digit is level number and last two digits are serial number from that level.

For example: HU19101 (Communication Skill)

HU- It belongs to Level 1 Science & humanities

19- 2019 curriculum

1- Level 1

01- Sr. No of Level 1 courses.

180 Credit Scheme P-19 Level Wise Marks Distribution

P-19 curriculum scheme is divided into 5 levels.

Level 1: Science & Humanities

Level 2: Core Technology Courses

Level 3: Applied Technology Courses

Level 4: Diversified Courses

Level 5: Management Courses

The distribution of credits and marks with reference to course levels is as given in following table.

Level No	Level	Credits	Percentage of Credits	Marks	Percentage of Marks
1	Science & Humanities	33	18.33%	650	17.1%
2	Core Technology Courses	55	30.55%	1300	34.21%
3	Applied Technology Courses	77	42.78	1600	42.10%
4	Diversified Courses	13	7.22%	250	6.58%
5	Management Courses	2	1.11	-	
	Total	**180**		**3800**	

List of Courses (Level wise)

Course Code	Course Title	Credits	Marks
Level 1: Science & Humanities			
SC19109	Basic Mathematics	4	100
HU19101	Communication Skill	4	150
SC19107	Engineering Chemistry	5	150
ME19102	Libre Office Suite (Spoken Tutorial)	4	-
SC19102	Engineering Physics	5	150
SC19110	Engineering Mathematics	4	100
ME19103	Environmental Studies (MOOC)	2	-
ME19101	English	5	-
	Total	**33**	**650**

Course Code	Course Title	Credits	Marks
Level 2: Core Technology Courses			
ME19201	Engineering Drawing I	6	100
WS19201	Workshop Practice	4	50
ME19204	Safety Practices	3	50
ME19209	Fundamentals of Electrical and Electronics Engineering	7	150
AM19201	Engineering Mechanics	5	150
ME19202	Engineering Drawing II	6	150
ME19203	Manufacturing Processes	6	150
ME19210	Strength of Mechanical Materials	5	125
ME19205	Basic Thermodynamics	4	125
ME19206	Theory of Machines	5	125
ME19207	Fluid Mechanics & Machinery	4	125
	Total	**55**	**1300**
Level 3: Applied Technology Courses			
ME19301	Machine Drawing & Computer Aided Drafting	4	50
ME19309	Materials Technology	5	150
ME19304	Power Engineering and Refrigeration & Air Conditioning	5	125
ME19306	Advanced Manufacturing Processes	5	150
ME19307	Production & Industrial Engineering	5	125
ME19312	Basics of Mechatronics	5	125
ME19310	Metrology & Quality Control	5	150
ME19305	CNC Machines & Automation	5	125
ME19302	Industrial Hydraulics and Pneumatics	5	125
ME19311	Design of Machine Elements	5	125
ME19303	Solid Modeling	4	50
ME19308	Project	4	100
ME19313	In-Plant Training	20	200
	Total	**77**	**1600**
Level 4: Diversified Courses			
ME19401	C Programming (Spoken Tutorial)	3	-
	Optional Course I		
ME19402	Automobile Engineering	5	125
ME19403	Mathematics for Mechanical Engineers		
ME19404	Non Conventional Energy Resources		

Course Code	Course Title	Credits	Marks
	Optional Course II		
ME19405	Tool Engineering	5	125
ME19406	Industrial Maintenance		
ME19407	Inventory Control		
	Total	**13**	**250**
Level 5: Management Courses			
ME19501	Entrepreneurship Development & Management	2	-
	Total	**2**	**-**
	Grand Total	**180**	**3800**

P19 Scheme Marks Analysis

Sr.No.	Details of Marks	Marks	Percentage
1	Total Marks as per scheme	3800	-
2	Theory	2400	63.16%
3	PR/OR/ TW	1400	36.84%
4	**Total**	**3800**	**100%**

Semester wise Distribution of Credits and Marks

Following table gives semester wise distribution of credits and marks for curriculum of Diploma in Mechanical Engineering.

Sr.	Semester	Credits	Marks
1	Semester I	30	600
2	Semester II	30	700
3	Semester III	30	700
4	Semester IV	35	800
5	Semester V	35	800
6	Semester VI	20	200
	Total	**180**	**3800**

List of Courses (Semester wise)

Course Code	Course Title	Credit	Course Marks
Semester I			
SC19109	Basic Mathematics	4	100
HU19101	Communication Skill	4	150
SC19107	Engineering Chemistry	5	150
ME19201	Engineering Drawing I	6	100
WS19201	Workshop Practice	4	50
ME19204	Safety Practices	3	50
ME19102	Libre Office Suite (Spoken Tutorial)	4	-
	Total	**30**	**600**
Semester II			
SC19102	Engineering Physics	5	150
SC19110	Engineering Mathematics	4	100
ME19209	Fundamentals of Electrical and Electronics Engineering	7	150
AM19201	Engineering Mechanics	5	150
ME19202	Engineering Drawing II	6	150
ME19401	C Programming (Spoken Tutorial)	3	-
	Total	**30**	**700**
Semester III			
ME19203	Manufacturing Processes	6	150
ME19210	Strength of Mechanical Materials	5	125
ME19205	Basic Thermodynamics	4	125
ME19206	Theory of Machines	5	125
ME19301	Machine Drawing & Computer Aided Drafting	4	50
ME19207	Fluid Mechanics & Machinery	4	125
ME19103	Environmental Studies (MOOC)	2	-
	Total	**30**	**700**
Semester IV			
ME19309	Materials Technology	5	150
ME19402	Automobile Engineering	5	125
ME19403	Mathematics for Mechanical Engineers		
ME19404	Non Conventional Energy Resources		
ME19304	Power Engineering and Refrigeration & Air Conditioning	5	125
ME19306	Advanced Manufacturing Processes	5	150
ME19307	Production & Industrial Engineering	5	125
ME19312	Basics of Mechatronics	5	125

Course Code	Course Title	Credit	Course Marks
ME19101	English	5	-
	Total	**35**	**800**
Semester V			
ME19405	Tool Engineering	5	125
ME19406	Industrial Maintenance		
ME19407	Inventory Control		
ME19310	Metrology & Quality Control	5	150
ME19305	CNC Machines & Automation	5	125
ME19302	Industrial Hydraulics and Pneumatics	5	125
ME19311	Design of Machine Elements	5	125
ME19303	Solid Modeling	4	50
ME19308	Project	4	100
ME19501	Entrepreneurship Development & Management	2	-
	Total	**35**	**800**
Semester VI			
ME19313	In-Plant Training	20	200
	Total	**20**	**200**
	Grand Total	**180**	**3800**

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -I**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
SC19109	BASIC MATHEMATICS	4	--	--	4	4	60	20	20	--	--	--	**100**
HU19101	COMMUNICATION SKILLS	2	2	--	4	4	60	20	20	25*	--	25	**150**
SC19107	ENGINEERING CHEMISTRY	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19201	ENGINEERING DRAWING -I	2	4	--	6	6	--	--	--	50*	--	50	**100**
WS19201	WORKSHOP PRACTICE	--	4	--	4	4	--	--	--	--	--	50	**50**
ME19204	SAFETY PPRACTICES	1	2	--	3	3	--	--	--	--	25	25	**50**
ME19102	LIBRE OFFICE SUITE (Spoken Tutorial)	--	4#	--	4	4#	--	--	--	--	--	--	**--**
	Total	**12**	**18**	**--**	**30**	**30**	**180**	**60**	**60**	**100**	**25**	**175**	**600**
	Student Centered Activity (SCA)				**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
Curriculum Development,
Dept. of Mechanical Engineering

Head of Department
Dept. of Mechanical Engineering

In-Charge
Curriculum Development Cell

Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -II**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
SC19102	ENGINEERING PHYSICS	3	2	--	5	5	60	20	20	25*	--	25	**150**
SC19110	ENGINEERING MATHEMATICS	4	--	--	4	4	60	20	20	--	--	--	**100**
ME19209	FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING	3	4	--	7	7	60	20	20	25	--	25	**150**
AM19201	ENGINEERING MECHANICS	3	2	--	5	5	60	20	20	25	--	25	**150**
ME19202	ENGINEERING DRAWING-II	3	3	--	6	6	60	20	20	--	--	50	**150**
ME19401	C PROGRAMMING (Spoken Tutorial)	--	3#	--	3	3	--	--	--	--	--	--	**--**
	Total	**16**	**14**	**--**	**30**	**30**	**300**	**100**	**100**	**75**	**--**	**125**	**700**
	Student Centered Activity (SCA)				**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral,TW: Term Work (progressive assessment)

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Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -III**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19203	MANUFACTURING PROCESSES	2	4	--	6	6	60	20	20	25*	--	25	**150**
ME19210	STRENGTH OF MECHANICAL MATERIALS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19205	BASIC THERMODYNAMICS	2	2	--	4	4	60	20	20	--	--	25	**125**
ME19206	THEORY OF MACHINES	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19301	MACHINE DRAWING & COMPUTER AIDED DRAFTING	--	4	--	4	4	--	--	--	25*	--	25	**50**
ME19207	FLUID MECHANICS AND MACHINERY	2	2	--	4	4	60	20	20	--	--	25	**125**
ME19103	ENVIRONMENTAL STUDIES	--	2#	--	2	2	--	--	--	--	--	--	**--**
	Total	**12**	**18**	**--**	**30**	**30**	**300**	**100**	**100**	**50**	**--**	**150**	**700**
	Student Centered Activity (SCA)				**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral,TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, @ indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# Indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
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Dept. of Mechanical Engineering

Head of Department
Dept. of Mechanical Engineering

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Curriculum Development Cell

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19309	MATERIALS TECHNOLOGY	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19402 ME19403 ME19404	**Optional Course-I** ***(Select any One)*** AUTOMOBILE ENGINEERING MATHEMATICS FOR MECHANICAL ENGINEERS NON CONVENTIONAL ENERGY RESOURCES	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19304	POWER ENGINEERING AND REFRIGERATION & AIR CONDITIONING	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19306	ADVANCED MANUFACTURING PROCESSES	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19307	PRODUCTION AND INDUSTRIAL ENGINEERING	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19312	BASICS OF MECHATRONICS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19101	ENGLISH	--	5#	--	5	5	--	--	--	--	--	--	**--**
	Total	**18**	**17**	**--**	**35**	**35**	**360**	**120**	**120**	**50**	**--**	**150**	**800**
Total Contact Hours					**35**								

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -V**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19405 ME19406 ME19407	**Optional Course-II** ***(Select any One)*** TOOL ENGINEERING INDUSTRIAL MAINTENANCE INVENTORY CONTROL	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19310	METROLOGY & QUALITY CONTROL	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19305	CNC MACHINES & AUTOMATION	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19302	INDUSTRIAL HYDRAULICS AND PNEUMATICS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19311	DESIGN OF MACHINE ELEMENTS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19303	SOLID MODELLING	--	4	--	4	4	--	--	--	25*	--	25	**50**
ME19308	PROJECT	--	4	--	4	4	--	--	--	--	50*	50	**100**
ME19501	ENTREPRENUERSHIP DEVELOPMENT & MANAGEMENT	--	2#	--	2	2	--	--	--	--	--	--	**--**
	Total	**15**	**20**	**--**	**35**	**35**	**300**	**100**	**100**	**50**	**50**	**200**	**800**
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral,TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -VI**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19313	INPLANT TRAINING	--	40	--	40	20	--	--	--	--	100*	100*	**200**
	Total	**--**	**40**	**--**	**40**	**20**	**--**	**--**	**--**	**--**	**100**	**100**	**200**
Total Contact Hours					**40**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

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Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

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Award of Diploma (Courses for Award of Diploma)

For the award of diploma in Mechanical Engineering programme, all courses of 5th semester and In-Plant training will be considered along with weightage from third semester to fourth semester courses as shown in following table-

Sr. No.		Marks
1	All courses of Vth Semester	800
2	In plant Training	200
3	Consolidated marks of third and fourth semester*	200
	Total Marks	**1200**

*Consolidated Marks of third and fourth semester: – the total marks of third and fourth semesters are converted to 100 marks each. These marks are then added (3rd Sem + 4th sem) as 100+100 = 200 marks.

Direct Second Year Admitted Students Backlogs:

The students admitted directly to second year have varied academic background. Hence they are required to complete some courses from previous semesters. The following is the guideline for the backlog courses **but the actual decision for backlog courses may vary from case to case of students, depending upon their academic background.**

Sr. No.	Academic Background	Backlog Course	Credit	Semester in which the course is offered
1	HSC (Science with Phy/ Chem/ Maths)	ME19202, Engineering Drawing-II	6	II Sem
2.	ITI	SC19109, Basic Mathematics	4	I Sem
3	HSC Vocational	SC19109, Basic Mathematics	4	I Sem
		ME19202, Engineering Drawing-II	6	II Sem

Department of Mechanical Engineering

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Course Equivalence for P16 & P19 Schemes

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MECHANICAL ENGINEERING DEPARTMENT
Course Equivalence chart (P-2016 Scheme V/S P-2019 scheme)

First Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
01	HU16101	Basics of Communications	HU19101	Communication Skills	Sem I
02	SC16107	Mathematics I	SC19109	Basic Mathematics	Sem I
03	SC16105	Engineering Chemistry	SC19107	Engineering Chemistry	Sem I
04	WS16201	Workshop Practice	WS19201	Workshop Practice	Sem I
05	ME16201	Engineering Drawing I	ME19201	Engineering Drawing-I	Sem I
06	HU16103	Generic Skills	---	---	No equivalent course in P19. Should be completed across the table.
07	HU16104	Environmental Studies	HU19102	Environmental Studies	Shifted from Sem I to Sem III
08	CO16201	Computer Fundamentals	---	---	No equivalent course in P19. Should be completed across the table.
09	NC16101	Yoga (Noncredit course)	---	---	No equivalent course in P19
10	NC16102	Social Work (Noncredit course)	---	---	No equivalent course in P19
11	---	---	ME19204	Safety Practices	New course induced in P19
12	---	---	ME19102	MOOC I Libre Office Suit	New course induced in P19

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MECHANICAL ENGINEERING DEPARTMENT
Course Equivalence chart (P-2016 Scheme V/S P-2019 scheme)

Second Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
01	HU16102	Communication Skills	---	---	No equivalence. Should be completed across the table.
02	SC16104	Engineering Physics	SC19102	Engineering Physics	Sem II
03	SC16108	Mathematics II	SC19110	Engineering Mathematics	Sem II
04	ME16202	Engineering Drawing II	ME19202	Engineering Drawing - II	Sem II
05	EE16203	Electrical Technology	---	---	No equivalence. Should be completed across the table.
06	AM16201	Engineering Mechanics	AM19201	Engineering Mechanics	Sem II
07	CO16202	C - Programming	---	---	No equivalence. Should be completed across the table.
08	---	---	ME19209	Fundamentals of Electrical and Electronics Engineering	New course induced in P19
09	---	---	ME19401	MOOC II C Programming (Spoken tutorial)	New course induced in P19

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GOVERNMENT POLYTECHNIC, MUMBAI
MECHANICAL ENGINEERING DEPARTMENT
Course Equivalence chart (P-2016 Scheme V/S P-2019 scheme)

Third Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
01	ME16308	Hydraulic Machines	ME19207	Fluid Mechanics And Machinery	Sem III
02	EC16210	Fundamentals of Electronics	---	---	No equivalence. Should be completed across the table.
03	AM16204	Strength of Materials	ME19210	Strength Of Mechanical Materials	Sem III
04	ME16205	Basic Thermodynamics	ME19205	Basic Thermodynamics	Sem III
05	ME16204	Theory of Machines	ME19206	Theory Of Machines	Sem III
06	ME16301	Machine Drawing	---	---	No equivalence. Should be completed across the table.
07	---	---	ME19301	Machine Drawing & Computer Aided Drafting	New course induced in P19
08	---	---	ME19103	MOOC III Environmental Studies	New course induced in P19

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GOVERNMENT POLYTECHNIC, MUMBAI
MECHANICAL ENGINEERING DEPARTMENT
Course Equivalence chart (P-2016 Scheme V/S P-2019 scheme)

Fourth Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
01	ME16401	Industrial Hydraulics and Pneumatics	ME19302	Industrial Hydraulic & Pneumatics	**Shifted to fifth semester**
02	ME16307	Production and Industrial Engineering	ME19307	Production And Industrial Engineering	Sem IV
03	ME16304	Applied Thermodynamics	---	---	No equivalence. Should be completed across the table.
04	ME16305	Manufacturing Process	ME19203	Manufacturing Processes	**Shifted to third semester**
05	ME16302	Computer Aided Drafting	---	---	No equivalence. Should be completed across the table.
06	ME16309	Physical Metallurgy & Materials	ME19309	Materials Technology	Sem IV
07	MG16502	Entrepreneurship Development	---	---	No equivalence. Should be completed across the table.
08	---	---	ME19402	Automobile Engineering	New course induced in P19
09	---	---	ME19403	Mathematics For Mechanical Engineers	New course induced in P19
10	---	---	ME19404	Non-Conventional Energy Resources	New course induced in P19

Fourth Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
11	---	---	ME19304	Power engineering and Refrigeration and Air conditioning	New course induced in P19
12	---	---	ME19101	MOOC IV English	New course induced in P19

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MECHANICAL e. DEPARTMENT
Course Equivalence chart (P-2016 Scheme V/S P-2019 scheme)

Fifth Semester					
P-2016 SCHEME			Equivalence in P-2019 Scheme		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
01	ME16402	Refrigeration and Air-Conditioning & Automobile Engineering	---	---	No equivalence. Should be completed across the table. Should be completed across the table.
02	ME16403	Tool Engineering	ME19405	Tool Engineering	Sem V
03	ME16404	Power Plant Engineering	---	---	No equivalence. Should be completed across the table.
04	ME16310	Metrology and Quality Control	ME19310	Metrology & Quality Control	Sem V
05	ME16306	Advanced Manufacturing Processes	ME19306	Advanced Manufacturing Processes	Shifted to fourth semester
06	MG16501	Industrial Organization and Management	---	---	No equivalence. Should be completed across the table.
07	ME16312	Project	ME19308	Project	Sem V
08	ME16303	Solid Modeling	ME19303	Solid Modeling	Sem V
09	ME16311	Design of Machine Elements	ME19311	Design of Machine Elements	Sem V
10	ME16406	Basics of Mechatronics	ME19312	Basics of Mechatronics	**Shifted to fourth semester**
11	--	--	ME19406	Industrial Maintenance	New course induced in P19
12	--	--	ME19407	Inventory Control	New course induced in P19

Fifth Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
13	--	--	ME19305	CNC Machines & Automation	New course induced in P19
14	--	--	ME19501	MOOC V Entrepreneurship Development & Management	New course induced in P19

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MECHANICAL ENGINEERING DEPARTMENT
Course Equivalence chart (P-2016 Scheme V/S P-2019 scheme)

Sixth Semester					
P-2016 SCHEME			**Equivalence in P-2019 Scheme**		
Sr. No	**Course Code**	**Name of Course**	**Course Code**	**Name of Course**	**Remark**
01	ME16405	In-plant Training	ME19313	In-Plant Training	Sem VI

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Policy for Course Detention P19

If the theory attendance of the student in any course in a semester is less than 75% and practical attendance is less than 100% (student has not completed all the prescribed practicals and not submitted the Term Work), he/she will be detained in that course at the end of the semester. Such student will not be allowed to appear for end semester examination of that course. Such students need to do course registration of that course again as per detention rules given below. Student has to satisfy the attendance and Term work criterion. After that he/she will be allowed for examination of that course. Rules of detention are as follows

- If a student is detained in any course of first year, he/she will not be eligible for second year admission, till he/she will not clear his/her detention.
- If a student is detained in any course of second year, he/she will not be eligible for third year admission, till he/she will not clear his/her detention.
- However, if a student is detained in any course of Odd semester, he/she can register for detained courses (maximum 2) in even semester, by paying additional fees as per rules.
- If a student is detained in any course of Even semester, he/she can register for detained courses (maximum 2) in vacation semester, for which he/she needs to pay additional fees as per rules of vacation semester.
- Student will not be eligible for registration of Inplant training unless, he/she completes minimum 100 credits.
- MOOC courses are exempted from above rules.
- Detention rule is not applicable for First Year Backlog courses of Direct Second Year admitted students.

GOVERNMENT POLYTECHNIC MUMBAI

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Department of Mechanical Engineering

P19 Curriculum

First Semester

GOVERNMENT POLYTECHNIC MUMBAI

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Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -I**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
SC19109	BASIC MATHEMATICS	4	--	--	4	4	60	20	20	--	--	--	**100**
HU19101	COMMUNICATION SKILLS	2	2	--	4	4	60	20	20	25*	--	25	**150**
SC19107	ENGINEERING CHEMISTRY	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19201	ENGINEERING DRAWING -I	2	4	--	6	6	--	--	--	50*	--	50	**100**
WS19201	WORKSHOP PRACTICE	--	4	--	4	4	--	--	--	--	--	50	**50**
ME19204	SAFETY PPRACTICES	1	2	--	3	3	--	--	--	--	25	25	**50**
ME19102	LIBRE OFFICE SUITE (Spoken Tutorial)	--	4#	--	4	4#	--	--	--	--	--	--	**--**
	Total	**12**	**18**	**--**	**30**	**30**	**180**	**60**	**60**	**100**	**25**	**175**	**600**
	Student Centered Activity (SCA)				**05**								
Total Contact Hours					**35**								

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Programme : **Diploma in CE/ME/IT/CO/EC/IS/EE(Sandwich Pattern)**										
Course Code: **SC19109**				Course Title**: BASIC MATHEMATICS**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs. 30 Min.)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
04	**-**	**-**	**04**	**60**	**20**	**20**	**-**	-	**-**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR- Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

This subject is kept under the branch of sciences. This subject intends to teach student basic facts ,concepts, principles, and procedure of mathematics as a tool to analyze engineering problems and as such lays down foundation for understanding the engineering and core technology subject.

Course Outcomes: Student should be able to

CO1	Identify the basic principles of mathematics about the field analysis of any engineering problem.
CO2	Apply rules ,concept and properties to solve the basic problems.
CO3	Establish relation between two variables.

Course Content Details:

Unit No	Topics / Sub-topics
1	**1.Trigonometry:** 1.1 Trigonometric ratios of allied angles, compound angles, multiple. angles (2A, 3A), Sub multiple angles 1.2 Factorization and De-factorization Formulae 1.3 Inverse Circular function (definition and simple problems). **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**2.Vectors:** 2.1 Definition of vector , position vector 2.2 Algebra of vectors(Equality, addition ,subtraction and scalar multiplication) 2.3 Dot (Scalar) product & Vector (Cross) product with properties. **Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U-4 , A-4)**
3	**3.Logarithms:** 3.1 Definition of logarithm 3.2 Laws of logarithm 3.3 simple examples based on laws. **Course Outcome: CO2 Teaching Hours : 10hrs Marks:10 (R-4 , U- 4 , A-2)**
4	**4.Probability :** 4.1 Definition of random experiment , sample space, event, occurance of event and types of event (Impossible , mutually exclusive , exhaustive ,equally likely) 4.2 Definition of Probability 4.3 Addition & Multiplication Theorems of probability without proof , simple examples **Course Outcome: CO1 Teaching Hours :10hrs Marks:10 (R-4, U- 4 , A-2)**
5	**5.Determinants:-** 5.1 Definition of Determinant 5.2 Expansion of Determinant of order 2X3 5.3 Crammer's rule to solve simultaneous equations in 3 unknowns **Course Outcome: CO2 Teaching Hours :10 hrs Marks:10 (R- 2 , U-4 , A-4)**
6	**6.Matrices:** 6.1 Definition of a matrix of order m x n 6.2 Types of matrices 6.3 Algebra of matrices - equality, addition,subtraction ,multiplication & scalar multiplication. 6.4 Transpose of matrix. 6.5 Minor , co-factor of an element. 6.6 Adjoint & inverse of a matrix by adjoint method. 6.7 Solution of a simultaneous equations by matrix inversion method. **Course Outcome: CO3 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U- 4 , A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Trigonometry**	04	04	02	10
2	**Vectors**	02	04	04	10
3	**Logarithms**	04	04	02	10
4	**Probability**	04	04	02	10
5	**Determinants**	02	04	04	10
6	**Matrices**	02	04	04	10
	Total	**18**	**24**	**18**	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mathematics for Polytechnic Students	S.P.Deshpande, Pune Vidyavardhini Graha Prakashan	-
2	Mathematics for Polytechnic Students (Volume I)	H.K.Dass, S.Chand Prakashan	9788121935241
3	Companions to Basic Maths	G.V.Kumbhojkar, Phadke Prakashan	10-B07951HJDQ 13-B07951HJDQ
4	Applied Mathematics	N.Raghvendra Bhatt late, Tata McGraw Hill Publication Shri R Mohan Singh	9789339219567, 9339219562

E-References:

1. www.math-magic.com
2. www.Scilab.org/-SCI Lab
3. www.mathworks.com/Products/Matlab/-MATLAB
4. www.wolfram.com/mathematica/-Mathematica
5. https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig
6. www.dplot.com/-Dplot
7. www.allmathcad.com/-Math CAD
8. www.easycalculation.com
9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1	1		1
CO2	3	2					1	1		1
CO3	3			2			1	1		1

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3			2			1	1	
CO2	3	2					1	1	
CO3	3			2			1	1	

CO Vs PO and CO Vs PSO Mapping (COMPUTER ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1	1		
CO2	3	2					1	1		
CO3	3			2			1	1		

CO Vs PO and CO Vs PSO Mapping (INFORMATION TECHNOLOGY)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1	1		1
CO2	3	2					1	1		1
CO3	3			2			1	1		1

CO Vs PO and CO Vs PSO Mapping (ELECTRONICS ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1		1	1
CO2	3	2					1		1	1
CO3	3			2			1		1	1

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1		1	
CO2	3	2					1		1	
CO3	3			2			1		1	

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3			2			1	1	1
CO2	3	2					1	1	1
CO3	3			2			1	1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Mrs. Deepawali S. kaware	Lecturer in Mathematics	Government polytechnic Vikaramgad
3	Mr. A.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai
4	Mr.V.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai

Head of Department

Coordinator,
Curriculum Development,
Department of Science And Humanities

Department of Science And Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in CE/ME/IT/CO/IS/EE/EC/LG/LT**										
Course Code: HU19101				**Course Title: Communication Skills (Sandwich Pattern)**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
TH	PR	TU	Total	TH (2 Hrs. 30 Min.)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
02	**02**	**-**	**04**	**60**	**20**	**20**	**25***	-	**25**	**150**

Abbreviations: TH- Theory; PR-Practical; TU-Tutorial; TS1 and TS2- Term Tests; OR-Oral Exam; TW: Term Work (progressive assessment), * Indicates assessment by External Examiner else internal assessment

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale: In this age of globalization, competition is tough. Hence effective communication skills are important. Communication skills play a vital and decisive role in career development. The subject of Communication Skills introduces basic concepts of communication. It also describes the verbal, non-verbal modes and techniques of oral & written communication. It will guide and direct to develop a good personality and improve communication skills. Students will be able to utilize the skills necessary to be a competent communicator. This will help the students to select and apply the appropriate methods of communication in various situations.

Course Outcomes: Student should be able to

CO1	Apply proper communication technique to cope up with the challenges of the modern world.
CO2	Interpret feedback at various situations by using appropriate body language and avoid the barriers in effective communication.
CO3	Able to participate in Group Discussion and Acquire the practical knowledge of an interview.
CO4	Able to develop PowerPoint Presentation and Business correspondence.
CO5	Write letters, circulars, memos, notices, reports and communicate effectively in written communication.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Communication** 1.1 Elements of Communication 1.2 Communication Cycle 1.3 Types of communication 1.4 Definition and Types of Barriers- a)Mechanical b)Physical c)Language d)Psychological 1.5 How to overcome Barriers **Course Outcome: CO1 Teaching Hours :6 hrs Marks: 14 (R- 2, U-4, A-8)**
2	**Non- verbal Communication** 2.1 Meaning and Importance of Non-verbal Communication 2.2 Body Language 2.3 Aspects of Body Language 2.4 Graphic language **Course Outcome: CO2 Teaching Hours :6 hrs Marks: 12 (R- 4, U-4, A-4)**
3	**Group Discussion And Interview Skills** 3.1 Need and Importance of Group Discussion 3.2 Use of Knowledge and Logical sequence. 3.3 Types of Interview 3.4 Preparing for an Interview **Course Outcome: CO3 Teaching Hours :6 hrs Marks: 10 (R-2, U-4, A-4)**
4	**Presentation Skills** 4.1 Presentation Skills - Tips for effective presentation 4.2 Guidelines for developing PowerPoint presentation **Course Outcome: CO4 Teaching Hours :4 hrs Marks: 08 (R- 2, U-2, A-4)**

5	**Business Correspondence** 5.1 Office Drafting – a) Notice b) Circular c) Memo d) Email-writing. 5.2 Job Application with resume. 5.3 Business Letters – a) Enquiry b)Order c)Complaint 5.4 Report Writing – a) Fall in Production b) Accident Report **Course Outcome: CO5 Teaching Hours: 8 hrs Marks: 16 (R- 4, U-4, A-8)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Communication	2	4	8	**14**
2	Non- verbal Communication	4	4	4	**12**
3	Group Discussion And Interview Skills	2	4	4	**10**
4	Presentation Skills	2	2	4	**8**
5	Business Correspondence	4	4	8	**16**
Total		**14**	**18**	**28**	**60**

List of experiments: Any 10 experiments out of 15

Sr. No.	Unit No	List of Experiments	CO	Hours
		PART A- GRAMMAR EXERCISES		
1		Articles	CO1	02
2		Preposition and Conjunction	CO1	02
3		Change the voice	CO1	02
4		Direct Indirect Speech	CO1	02
5		Vocabulary Building	CO1	02

		PART B - COMMUNICATION SKILLS – PRACTICE		
6	1	Conversation between students on various situations.	CO1,CO4	02
7	3	Non- Verbal Communication.	CO2,CO4	02
8	3	Group Discussion	CO3,CO4	02
9	4	Mock Interview	CO3,CO4	02
10	5	Business Communication a) Advertisement, Tender, Diary writing. b) Job Application With Resume.	CO4,CO5	02
11	1	Communication Barriers	CO1	02
12	5	Business Letters – a) Enquiry b)Order c)Complaint	CO5	02
13	4	Speeches- a)Welcome Speech b)Farewell Speech c) Vote of Thanks	CO1,CO4	02
14	5	Report Writing – a) Fall in Production b) Accident Report	CO5	02
15	All	Showing Videos on different types of Communication.	CO4	02
		Total		**30**

Note: Experiments No. 1 to 10 are compulsory and should map all units and Cos.
Remaining experiments are to be performed on the importance of topic/availabilityoftime.

References/ Books:

Sr. No.	**Title**	**Author, Publisher, Edition and Year Of publication**	**ISBN**
1	Communication Skills	Joyeeta Bhattacharya - Reliable Series	9780000176981, 0000176982
2	Communication Skills	Sanjay Kumar, PushpaLata- Oxford University Press	13: 978-0199488803
3	Successful presentation Skills	Andrew Brad bury- The Sunday Times	13: 9780749456627

E-References:

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2. Website:www.inc.com/guides/growth/23032.html-4

3. Website: www.khake.com/page66htm/-72k
4. Website: www.BM Consultant India Consultant India.Com
5. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-English
6. MYCBSEGUIDE
7. Website: www.letstak.co.in

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	1	2	1
CO2	3	3	2	3	2	3	2	1	2	1
CO3	3	2	2	1	2	3	2	1	2	1
CO4	3	3	2	1	2	3	2	1	2	
CO5	3	3	2	1	2	3	2	1	2	

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	3	2	3	2	2	1
CO2	3	3	2	3	2	3	2	2	1
CO3	3	2	2	1	2	3	2	2	1
CO4	3	3	2	1	2	3	2	2	1
CO5	3	3	2	1	2	3	2	2	1

CO Vs PO and CO Vs PSO Mapping (ELECTRONICS ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	2	2	
CO2	3	3	2	3	2	3	2	1	2	1
CO3	3	2	2	1	2	3	2	1	1	1
CO4	3	3	2	1	2	3	2	1		
CO5	3	3	2	1	2	3	2	1		

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3

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

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**
CO1	3	3	2	3	2	3	2	1	2
CO2	3	3	2	3	2	3	2	1	2
CO3	3	2	2	1	2	3	2	1	2
CO4	3	3	2	1	2	3	2		2
CO5	3	3	2	1	2	3	2		

CO Vs PO and CO Vs PSO Mapping (COMPUTER ENGINEERING)

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	2	1	2	1
CO2	3	3	2	3	2	3	2	1	2	1
CO3	3	2	2	1	2	3	2	1	2	1
CO4	3	3	2	1	2	3	2		2	
CO5	3	3	2	1	2	3	2		2	

CO Vs PO and CO Vs PSO Mapping (INFORMATION TECHNOLOGY)

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	2	2	1	1
CO2	3	3	2	3	2	3	2	2	1	1
CO3	3	2	2	1	2	3	2	1		2
CO4	3	3	2	1	2	3	2	1		
CO5	3	3	2	1	2	3	2	1		

CO Vs PO and CO Vs PSO Mapping (LG/LT ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	2	1		2
CO2	3	3	2	3	2	3	2	1		2
CO3	3	2	2	1	2	3	2	1	1	2
CO4	3	3	2	1	2	3	2	1		2
CO5	3	3	2	1	2	3	2	1		2

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3	Mrs. K.S.Pawar	Lecturer in English	Government polytechnic Mumbai
3	N.N.Dhake	Lecturer in English	Government polytechnic Mumbai

Coordinator,

Curriculum Development,

Department of Science And Humanities_____

I/C, Curriculum Development Cell

Head of Departments

Department of Science And Humanities_____

Principal

Programme : **Diploma in CE/ME(Sandwich Pattern)**										
Course Code: **SC19107**				Course Title: **Engineering Chemistry**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2.30 Hrs.)	TS1 (1 Hr.)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25***	---	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rationale:

The subject is included under category of basic sciences. The role is to understand the fundamental concepts and facts about infrastructure of physical matters and their interrelationship. This will provide input for better understanding of other foundation and technology subjects

Course Outcomes: Student should be able to

CO1	Apply the principles of chemistry under different engineering situations.
CO2	Apply various applications of electrolysis in engineering field.
CO3	Illustrate various methods of softening of hard water
CO4	Adopt methods of prevention of corrosion for environmental and safety concerns.
CO5	Select suitable Lubricants, material for a particular use effectively.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Atomic Structure** 1.1 Introduction of atom, Molecules, Fundamental Particles, Proton, Neutron, Electron. their mass, charge, location. And symbol Bohr's theory, Postulates, Structure of modern atom. 1.2 Atomic number and atomic mass number. Atomic weight Numerical based on atomic number & atomic mass number 1.3 Rules governing filling up of atomic orbitals, Quantum no.Paulis Exclusion Principle, Aufbau's Principle, Hund's rule. Electronic configuration of atoms up to atomic number 30 1.4 Valence and chemical bonding. Valence: Definition, & examples. Types of valance :Electrovalence & Co-valance 1.5 Electrovalent bond: Definition, Formation. Formation of NaCl 1.6 Co-valent bond : Definition & formation Formation of following molecules Single bond:, Chlorine. Double bond : Oxygen,, Triple Bond : Nitrogen,, 1.7 Distinction between electrovalent and covalent compound. **Course Outcome: CO1 Teaching Hours : 8 hrs Marks: 10 (R- 2, U-4, A-4)**
2	**Electrochemistry** 2.1 Definition of Electrochemistry, Electrolytes: Definition, Types. Differences between Atom and ion. Definition of ionization & electrolytic dissociation, Arrhenius theory, Degree of ionization with factors affecting it. 2.2 Terms related to Electrolysis Mechanism of electrolysis. Examples of: mechanism of Electrolysis of $CuSO_4$ by using Cu electrodes. 2.3 Faradays First law and its mathematical derivation. Faradays second law & its mathematical derivation, Numerical based on laws of Faraday. 2.4 Application of Electrolysis: Electroplating. **Course Outcome: CO2 Teaching Hours : 8 hrs Marks: 10 (R- 4 , U-4 , A-2)**
3	**Water** 3.1 Sources of water, impurities present in water.(suspended, dissolved, colloidal, biological) Types of water: hard & soft Causes of hardness of water Types of Hardness, Unit of hardness, Definition of hardness. 3.2 Bad effects of Hard Water for Domestic purposes.& Industrial purposes (Textile ,Dyeing, Sugar industry, Bakery) 3.3 Bad effects of hard water in Boiler, Scales and Sludge's, causes of their formation, their disadvantages and their removal. 3.4 Treatment of hard water for industrial purposes by Zeolite &Ion Exchange process 3.5 Treatment of hard water for drinking purposes.(city water supply) Various steps: Screening, Sedimentation, Coagulation, Filtration, Sterilization by boiling. 3.6 pH value: Definition, Formula, pH scale, its salient features, Numerical based on pH, Applications of pH related to Engg .field (corrosion of bridges, Electroplating,).

	Course Outcome: CO3 Teaching Hours : 8 hrs Marks: 10 (R-2 , U- 4 , A-4)
4	**Corrosion** 4.1 Definition of corrosion. Types of corrosion. Atmospheric & Electrochemical Corrosion. 4.2 Mechanism of atmospheric corrosion, types of oxide films formed,(stable, unstable, volatile, with examples) 4.3 Electrochemical corrosion/immersed corrosion Definition. Example. Factors Affecting, Atmospheric & Electrochemical Corrosion. 4.4 Protection of metals from Corrosion:- By protective coatings a) organic coating (Paints and Varnishes), b)inorganic coating (Metallic Coating) 4.5 Different methods of Protective metallic coatings. A) Hot dipping (Galvanizing & Tinning) b) Sherardizing c) Metal Spraying **Course Outcome: CO4 Teaching Hours :8 hrs Marks: 10 (R-2, U- 4 , A-4)**
5	**Lubricants** .1 Definition of lubricant, example, functions of lubricant, classification of lubricants (solid, semi-solid and liquid) examples. Conditions under which each lubricant is used. 5.2 Lubrication: definition and types conditions under which each lubricant is used. Types of lubrications, Fluid film, Boundary, Extreme pressure lubrication. Definition, diagram & description of each type. 5.3 Characteristic of good lubricant A) Physical Characteristics • Viscosity • Viscosity index • Oiliness • Volatility • Flash point & Fire Point • Cloud and Pour point B) Chemical Characteristics • Acidity /Neutralization no. • Emulsification Saponification value **Course Outcome: CO5 Teaching Hours : 6 Marks: 10 (R- 4 , U-4 , A-2)**
6	**Nonmetallic Engineering Material** 6.1 Definition of nonmetallic engineering materials **6.2 Plastic :** definition , example Polymerization : definition ,Types of Polymerization addition and conde Addition polymerization : definition formation of polyethylene , Condensation-polymerization : definition Formation Of nylon-66 Types of plastic: thermo softening, thermo setting plastics, Differences between them. Compounding of plastic , Materials needed for it (pigments, fillers, Plasticizers

	Accelerators etc.,) Properties and engineering applications of plastic. **6.3 Rubber:** definition of rubber (elastomer) Natural rubber : Basic unit in natural rubber(isoprene) Occurrence & Processing of Latex .Drawbacks of natural Rubber, Vulcanization Of rubber: Chemical reactions, ,Types of Rubber Synthetic rubber Importance ,difference , Example B u rubber, Thiokol, Neoprene Properties of rubber: Elasticity, Tack, Rebound ,Abrasion resistance Applications of rubber **6.4 Thermal insulating materials** Definition, Examples Thermocole, Glass wool. **T hermocole**: Definition, Preparation, Properties & uses, **G lass wool**: Definition, Preparation, Properties & uses **Course Outcome: CO5 Teaching Hours : 7 hrs Marks: 10 (R- 2 , U- 6 , A- 2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Atomic Structure**	02	04	04	10
2	**Electrochemistry**	04	04	02	10
3	**Water**	02	04	04	10
4	**Corrosion**	02	04	04	10
5	**Lubricants**	04	04	02	10
6	**Nonmetallic Engineering Materials**	02	06	02	10
	Total	**16**	**26**	**18**	**60**

List of experiments:

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1	Introduction of chemistry laboratory &safety measures.	2
2	2	CO2	Determination of conductivity of different electrolytes by using conductivity meter.	2
3	3	CO3	Estimation of Chloride content from given water sample	2
4	4	CO4	Estimation of percentage purity of iron from the given alloy sample	2
5	5	CO5	To find out acid value of given lubricant	2
6	1	CO1	Basic radicals : $Cu^{++,}$ Fe^{++}, $Fe^{+++,}$ Cr^{+++}, Mn^{++}, Ni^{++}, $Zn^{++,}$ $Ca^{++,}$ $Ba^{++,}$ Mg^{++} $NH4^{+}$ **Acidic Radicals**: $\mathbf{Cl^{-}}$,$\mathbf{Br^{-}}$,$\mathbf{I^{-}}$,$\mathbf{CO_3^{--}}$, $\mathbf{SO_4^{--}}$,$\mathbf{NO_3^{-}}$	6
7	2	CO2	Determination of electrochemical equivalent of copper by using cu -electrodes	2
8	3	CO3	Find out the total hardness from given sample of water by EDTA method	2
9	4	CO4	To Study Corrosion of Aluminum rod in acidic and basic medium and plot a graph of rate of corrosion.	2
10	5	CO5	Determination of coefficient of viscosity of given oil (Glycerin) by using Ostwald's Viscometer	2
11	3	CO3	To find out pH of different solutions using Lovibond comparator, pH paper, pH meter.	2
12	4	CO4	Estimation of moisture content in given coal sample	2
13	6	CO5	Preparation of phenol formaldehyde / Bakelite plastic	2
			Total	**30**

Note: Experiments No. 1 to 10 are compulsory and should map all units and Cos. Remaining experiments are to be perform on the basis of availability of time.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering Chemistry	M.M. Uppal, Khanna Publisher, Delhi	978-81-7409-262-5
2	Polytechnic Chemistry	V.P. Mehta, Jain Brothers, Delhi	978-81-8360-093-X
3	Applied Chemistry	P.C. Jain, Monica Jain, Dhanpat Rai and Sons , Delhi	13: 9788187433170
4	Chemistry in Engineering and technology Volume 1 and 2	J.C. Kurlacose, J. Jairam Tata Mcgraw hill.	9780074517352

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2. www.chemistryclassroom.com
3. www.youtube/chemistry
4. www.ferrofchemistry.com
5. http;//hperchemistry.phastr.gsu.edu/hbase/hph.htm
6. www.sciencejoywagon.com/
7. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-chemistry

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	1	1		1	
CO2	3	2	1	2	2	2	1			
CO3	3	2	1	1	2	2	1		1	
CO4	3	2	1	2	2	2	1		1	
CO5	3	2	1	2	2	2	1			1

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	1	2	2	1	1	1	1
CO2	3	2	1	2	2	2	1	1	1
CO3	3	2	1	1	2	2	1	1	2
CO4	3	2	1	2	2	2	1	2	2
CO5	3	2	1	2	2	2	1	2	2

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1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
2	Mrs Vaishali Gokhale	Lecturer in Chemistry	Government Polytechnic Pune
3	Dr. Mrs. Smita Petkar Dhopate	Lecturer in Chemistry	Government Polytechnic Nagpur
4	Mrs J. V. Iyengar	Lecturer in Chemistry	Government Polytechnic Mumbai
5	Mrs S.M. Patil	Lecturer in Chemistry	Government Polytechnic Mumbai

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Curriculum Development,
Department of Sci. & Humanities

Head of Departments
Department of Sci. & Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical/Civil/ Engineering/Leather Technology (Sandwich Pattern)**										
Course Code:ME19201				Course Title: Engineering Drawing-I						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
02	**04**	**-**	**06**	**-**	**-**	**-**	**50***	-	**50**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at mid-term and second skill test at the end of the term.

Rationale:

Engineering drawing is the common graphical language of engineers, technicians and workers to express engineering ideas and concepts. Correct interpretation of engineering drawings is one of the basic duties of First Line Supervisors. Study of Engineering Drawing induces the concepts of accuracy and exactness of information necessary for the production of engineering component. It also develops judgements about distances and angles.

This basic course aims at building a foundation for the further courses in drawing and other allied subjects. This course is useful in developing imagination, drafting and sketching skills of the students.

Course Outcomes: Student should be able to

CO1	Draw geometric figures and engineering curves using appropriate drawing instruments
CO2	Draw views of line and plane, by applying principles of first angle method of projections
CO3	Draw orthographic views of given object by applying principles of orthographic projections
CO4	Draw isometric view from given orthographic views, by applying principles of isometric projections
CO5	Draw the free hand sketches of given engineering objects/elements

Course Content Details:

Unit No	Topics / Sub-topics
1	**Principles of Drawing** 1.1 Drawing instruments and their uses, Standard sizes of drawing sheets (ISO-A series),letters and numbers(single stroke vertical), Conventions of lines and their applications, Drawing Scales (reduced, enlarge and full size), Methods of Dimensioning: Chain, parallel and coordinate dimensioning (Refer SP-46Codelatest Edition) 1.2 Simple Geometrical Constructions, Redrawing figures using above geometrical constructions **Course Outcome- CO1 Teaching Hours – 04 Marks –06**

2	**Engineering Curves and Loci of Points** 2.1 Method to draw Ellipse by Arcs of Circle Method and Concentric Circle Method. 2.2 Method to draw Parabola and Hyperbola by Directrix and Focus Method. 2.3 Methods to draw Involutes of circle and pentagon, 2.4 Methods to draw Cycloid, 2.5 Loci of Points of Single Slider Crank Mechanism with given specifications. **Course Outcome- CO1 Teaching Hours – 06 Marks –06**
3	**Projection of lines and planes** 3.1 Concepts of Reference Planes and Projections, Views – Top, Front, Side Views 3.2 Projections of Line inclined to one reference plane (H.P/V.P) and limited to both ends in one quadrant only. 3.3 Projections of simple planes of circular, square rectangular, rhombus, pentagonal and hexagonal shape, inclined to one reference plane and perpendicular to other **Course Outcome- CO2 Teaching Hours – 06 Marks –10**
4	**Orthographic projections** 4.1 Introduction to orthographic projections, Symbol of First Angle Projection, Conversion of pictorial view into orthographic views –Top, Front and End View of objects containing plain surfaces, slant surfaces, slots, ribs, cylindrical surfaces. (First Angle Projection Method Only) 4.2 Sectional Orthographic Views and conversion of pictorial view into sectional 4.3 Orthographic views (Objects involving plain surfaces, slant surfaces, slots, ribs, cylindrical surfaces, threads etc.) **Course Outcome- CO3 Teaching Hours – 06 Marks –12**
5	**Isometric projections** 5.1 Isometric scale, Comparison of Natural Scale with Isometric Scale 5.2 Conversion of Orthographic Views into Isometric View/Projection (Objects involving plain surfaces, slant surfaces, slots, ribs, cylindrical surfaces, holes etc.) **Course Outcome- CO4 Teaching Hours – 06 Marks –12**
6	**Free hand sketches** 6.1 Drawing of proportional freehand sketches of – Different types of thread forms, nuts, bolts, screws, washers and foundation bolts (Rag and Lewis type) (Teacher shall also explain use/ function of all the above elements) **Course Outcome- CO5 Teaching Hours – 02 Marks –04**

List of Sheets: All sheets compulsory

Sr. No.	Unit No	CO	List of Drawing Sheets	Hours
1	1	CO1	**Basics of Engineering Graphics** Drawing sheet containing types of lines, Lettering, Redrawing given figure, dimensioning and geometrical constructions	08
2	2	CO1	**Engineering curves and loci points** (minimum 4 problems)	08

Sr. No.	Unit No	CO	List of Drawing Sheets	Hours
3	3	CO2	**Projections of Lines and Planes** Three cases on lines and three cases on planes	08
4	4	CO3	**Orthographic projections** Using first angle method of projections (minimum 2 problems)	08
5	4	CO3	**Sectional Orthographic projections** Using first angle method of projection (minimum 2 problems)	08
6	5	CO4	**Isometric Projection-I** Using isometric scale (minimum 2 objects)	08
7	5	CO4	**Isometric Projection-II** To draw isometric views of objects including slots, holes and sloping faces (minimum 2 objects)	08
8	6	CO5	**Free hand sketches** To draw free hand sketches of different types of threads forms, nuts, bolts and screws, foundation bolts.	04
Total				**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering drawing	N.D.Bhatt, Charotar Publishing House, 53rd Edition, 2016	978-9380-3581-78
2	Engineering Graphics	P.J. Shah, S. Chand, revised edition,2014	978-8121-9296-79
3	Engineering Drawing	Amar Pathak, Wiley Publication,10th Ed. 2010	978-9350-0401-64
4	Engineering drawing	D.Jolhe, Tata McGraw Hill Education, 1st Ed, 2017	978-0070-6483-71
5	Textbook on engineering drawing	K.L.Narayan,P.Kannaiah, Scitech publications, 24th reprint, 2010,	978-8183-7142-28
6	Engineering drawing practice For school and colleges	IS Code SP-46	-

E-References:

1. https://ocw.mit.edu.courses.drawing
2. https://nptel.in.courses.drawin
3. https://home.iiik.edp.ac.in

CO Vs PO and CO Vs PSO Mapping (Mechanical Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	1	1	1	1	2	1	1
CO2	2	2	2	1	1	1	2	1	1
CO3	3	2	2	2	1	2	2	1	1
CO4	3	2	2	2	2	2	2	1	1
CO5	2	1	1	1	1	1	2	1	1

CO Vs PO and CO Vs PSO Mapping (Civil Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	2	1	1	1
CO2	2	2	2	1	1	1	2	1	1	1
CO3	3	2	2	2	1	2	2	1	1	1
CO4	3	2	2	2	2	2	2	1	1	1
CO5	2	1	1	1	1	1	2	1	1	1

CO Vs PO and CO Vs PSO Mapping (Leather Technology)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	2	1	1	1
CO2	2	2	2	1	1	1	2	1	1	1
CO3	3	2	2	2	1	2	2	1	1	-
CO4	3	2	2	2	2	2	2	1	1	-
CO5	2	1	1	1	1	1	2	1	1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Ruhil Alwi	Sr. Executive	Coffee Day Beverages, Mumbai
2	Mr. A.S. Sangwikar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Thane
3	Mr. U.A. Agnihotri	Lecturer in Mechanical Engineering	Govt. Polytechnic, Mumbai
4	Mr. E.C. Dhembre	Lecturer in Mechanical Engineering	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : ME/CE/IS (Sandwich Pattern)										
Course Code: WS19201				Course Title: Workshop Practice						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 minutes)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
-	**4**	**-**	**4**	**-**	**-**	**-**	**-**	**-**	**50**	**50**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops. The knowledge of basic shops like Wood working, Fitting, Welding, Plumbing and Sheet Metal shop is essential for technicians to perform their duties in industries. Irrespective of engineering stream, the use of workshop practices in day to day industrial as well domestic life helps to solve various minor but critical problems. Working in workshop develops the attitude of working in a group and the basis for safety awareness is created. This foundation course intends to impart basic know-how of various hand tools and their use in different sections of manufacturing. The students are advised to undergo each skill experience with remembrance, understanding and application with special emphasis on attitude of enquiry to know why and how for the various instructions and practices imparted to them in each hop. Furthermore the demonstration of CNC Machine will give feel of advancement in industry.

Course Outcomes: At the end of the course student will be able to:

CO1	Lay-outing of shop & Sketching of jobs, tools & equipment.
CO2	Select appropriate tools, machinery, equipment and consumables for given application.
CO3	Use & Operate hand tools, equipment and machinery in different shops.
CO4	Prepare the simple jobs as per specification & drawing.
CO5	Maintain workshop related tools, equipment and machineries.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to workshop** 1.1 Workshop layout, Importance of various sections/shop of workshop, Types of jobs done in each shop. 1.2 Causes of accidents, general safety rules and work procedure in workshop, Safety signs and symbols, First Aid. 1.3 Fire, Causes of Fire, Basic ways of extinguishing the fire. Classification of fire, Firefighting equipment, fire Extinguishers and their types. 1.4 Issue and return system of tools, equipment and consumables. **Course Outcome: CO1,CO2 Teaching Hours: 06**
2	**Smithy and Forging** 2.1 Sketching, understanding the specifications, materials, various applications and methods used in Smithy and Forging shop along with use of tools like anvil, hammers, Swage block, tongs, chisels, flatters etc. 2.2 Demonstration of Smithy and Forging operations like bending, setting down, bulging, Upsetting etc. 2.3 Preparation of smithy & forging, job. 2.4 Safety precautions & Personal Protective Equipment **Course Outcome: CO1,CO2,CO3,CO4, CO5 Teaching Hours:10**
3	**Carpentry Section** 3.1 Types of wood and their applications 3.2 Types of carpentry hardware's and their uses 3.3 Sketching, understanding the specifications, materials, various applications and Methods used in Carpentry shop along with use of tools like saws, planner, chisels, Hammers, mallet, marking gauge, Vice, try square, rule, etc. 3.4 Demonstration of carpentry operations such as marking, sawing, planning, chiseling, Grooving, boring, joining, etc. 3.5 Preparation of wooden joints 3.6 Safety precautions & Personal Protective Equipment **Course Outcome: CO1,CO2,CO3,CO4, CO5 Teaching Hours:10**
4	**Welding Section** 4.1 Types, sketching, understanding the specifications, materials and applications of arc & Gas welding accessories and consumables 4.2 Demonstration of metal joining operations like arc welding, soldering and brazing, effect of Current and speed. Also demonstrate various welding positions. 4.3 Demonstrate gas cutting operation. 4.4 Preparation of metal joints. 4.5 Safety precautions & Personal Protective Equipments. **Course Outcome: CO1,CO2,CO3,CO4, CO5 Teaching Hours:10**

5	**Fitting Section** 5.1 Sketching, understanding the specifications, materials, various applications and methods used in fitting, marking, measuring, work holding, cutting & finishing tools. 5.2 Demonstration of various fitting operations such as chipping, filing, scraping, grinding, Sawing, marking, Drilling ,tapping, etc. 5.3 Preparation of male, female joint. 5.4 Safety precautions & Personal Protective Equipments **Course Outcome: CO1,CO2,CO3,CO4, CO5 Teaching Hours:12**
6	**Plumbing Section** 6.1 Types, specification, material, applications and demonstration of pipe fitting tools. 6.2 Demonstration of pipe fitting operations such as marking, cutting, bending, threading, assembling, Dismantling etc. 6.3 Types and application of various spanners such as flat, fix, ring, box, adjustable etc. 6.4 Preparation of pipe fitting jobs. 6.5 Concept and conversions of SWG and other gauges in use. Use of wire gauge. 6.6 Safety precautions & Personal Protective Equipments **Course Outcome: CO1,CO2,CO3,CO4, CO5 Teaching Hours: 06**
7	**Lathe and CNC Operations** 7.1 Working principle of lathe along with sketch. Maintenance procedure of Lathe Machine. 7.2 Demonstration of Lathe machine operation like plain turning, taper turning, threading, chamfering, etc. 7.3 Simple job demonstration for a group on CNC Mill/lathe Machine. **Course Outcome:CO5 Teaching Hours: 06**

List of experiments:

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1	Causes of accidents, general safety rules and work procedure in workshop, Safety signs and symbols, First Aid. Perform mock drill session in group of minimum 10 students for Extinguishing fire.	06
2	2	CO1,CO2,CO 3,CO4, CO5	Prepare job involving operations like bending, setting down, bulging, upsetting etc; e.g. Pegs (Square/round), Hook, Hammer tongue, Agro equipment etc. (Individually)	10
3	3	CO1,CO2,CO 3,CO4, CO5	Prepare two wooden joints as per given drawings. (Individually)	10
4	4	CO1,CO2,CO 3,CO4, CO5	Prepare lap joint/butt joint using either arc / gas welding as per given drawing.(Individually)	10
5	5	CO1,CO2,CO 3,CO4, CO5	Prepare one Male- Female type fitting job as per given drawing. (Individually)	12
6	6	CO1,CO2,CO 3,CO4, CO5	Prepare two pipe joints as per given drawings. (Individually)	06
7	7	CO5	Demonstration of Lathe machine & CNC machine operations	06
			Total	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Workshop Technology - 1	Hazra and Chaudhary Media promoters & Publisher private limited.	978-8185-0991-49
2	Workshop Technology - 1	W.A.J. Chapmam Taylor & Francis.	978-0713-1326-94
3	Workshop Practice Manual for Engineering Diploma & ITI Students	Hegde.R .K, Sapna Book House, 2012,	979-8128-0058-30
4	Workshop Familiarization	E. Wilkinson Pitman engineering craft series, 1972	978-0273-3167-56
5	Mechanical workshop practice.	K.C.John, PHI, 2010	978-812-03416-61
6	Workshop practice manual	K. Venkata Reddy, B. S. Publications, 6th Ed, 2015	978-8178-0030-78

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2. http://wwwabmtools.com/downioads/Woodworking%20Carpentry%20Tools.pdf d.
3. http://www.weldingtechnology.org e.http://www.newagepublishers.com
4. http://wwwyoutube.com/watch?v=TeBX6cKKHWY g
5. http://wwwyoutube.com/watch?v=QHF0sNHnttw&feature=related h
6. http://www.youtube.com/watch?v= K v l zo9CAxt4&feature=relmfu i.
7. http://sourcing.indiamart.com/engineerig/articles/materials-used-hand-tools/

CO Vs PO and CO Vs PSO Mapping (Mechanical Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	2	1	2	2	1	2	2
CO2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2
CO4	3	3	3	3	3	3	3	2	2
CO5	2	2	2	2	2	2	2	2	2

CO Vs PO and CO Vs PSO Mapping (Civil Engineering)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2	1	2	2	--
CO2	2	2	2	2	2	2	2	2	2	--
CO3	2	2	2	2	2	2	2	2	2	--
CO4	3	3	3	3	3	3	3	2	2	--
CO5	2	2	2	2	2	2	2	2	2	--

CO Vs PO and CO Vs PSO Mapping (Instrumentation)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	2	1	2	2	1	2	1
CO2	2	2	2	2	2	2	2	2	1
CO3	2	2	2	2	2	2	2	2	1
CO4	3	3	3	3	3	3	3	2	1
CO5	2	2	2	2	2	2	2	2	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Shri. S. V. Joshi	Lecturer in Mechanical Engineering & I/c Workshop Superintendent	Govt. Polytechnic, Mumbai
2	Shri. N. M. Ambadekar	Workshop Superintendent,	Govt. Polytechnic, Thane
3	Shri. D. B. Jadhav	Senior Manager	Auto. Division, Mahindra and Mahindra Ltd., Kandivali

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Workshop Superintendent
Department of Workshop

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:ME19204				Course Title: Safety Practices						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
1	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**25**	**25**	**50**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Safety of human life and assets are of top priority in industrial and social world. Accidents not only severely affect the victims but also to society and nation. Mechanical Engineering Technician leads the work team as First Line Supervisor. Hence along with other performances, he/she is also responsible for safe working practices and prevention of accidents at work place. He/She has to motivate the subordinates for safe working practices. The supervisor must have the basic understanding of safety aspects at workplaces and in general life also.

As safety is related to affective domain of learning, hence the course is required to be introduced at early stage of professional education.

Course Outcomes: Student should be able to

CO1	Describe effects of accidents on individual, industry and society, principles of accident prevention and home and public safety issues, basics of industrial safety, occupational health hazards and first aid techniques.
CO2	Describe safety practices at laboratories, workshop, workplaces related with handling of hand tools, power tools, chemicals, machine guarding and identify safe/ unsafe working conditions
CO3	Select appropriate personal protective equipment under given situation
CO4	Choose and Use appropriate fire extinguishers and follow fire prevention practices
CO5	Identify electric hazards for prevention of accidents.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Importance of Safety and Accident Prevention** 1.1 Accidents, Causes of Accident, Cost of accident, 1.2 Effects of accident on individual, industry, society and nation, 1.3 Causes of Accidents Unsafe Conditions, Unsafe Acts , Human factors, Principles of accident prevention 1.4 Safety at Home: Safe use of Gas Cylinder & stove, Slippery & wet surfaces, Safe use of Lifts/ elevators,

	1.5 Preparedness at home: Earthquake response, First Aid Box, List of Contacts 1.6 Safe driving, safe use of public transport- Buses & Trains, 1.7 Unsafe behavior of Crowd & its management **Course Outcome- CO1 Teaching Hours – 03**
2	**Safety in Laboratories, Workshop & Workplaces** 2.1 Safe storage and Use of hazardous Chemicals 2.2 Safe use of Hand tools and Power tools such as electrically powered l tools, pneumatic tools, hydraulic tools, grinding tools, 2.3 Safe Lifting Practices 2.4 Machine guarding- Need of machine guarding, Types of machine guards, Legal requirements 2.5 Safe working conditions: Ventilation, Illumination, Temperature, vibrations, Safe use of Computers, postures and ergonomics etc. **Course Outcome- CO2 Teaching Hours – 03**
3	**Personal Protective Equipment** 3.1 Personal Protective equipment for – Hand protection, Foot protection, Head Protection, Eye Protection, Face Protection Skin, Body Protection, Protection against fall & working at heights, Hearing/ Noise Protection, Respiratory Protection 3.2 Selection of PPE **Course Outcome- CO3 Teaching Hours – 02**
4	**Fire Prevention** 4.1 Chemistry of Fire, Fire Triangle, Classification of Fires, Stages of Fire, 4.2 Causes of General and Industrial Fires, Prevention of fires at home, buildings and industries 4.3 Fire detection systems, fire extinguishers& their use, Automatic fire extinguishing system, Personal rescue during fire **Course Outcome- CO4 Teaching Hours – 03**
5	**Introduction to Electrical Safety** 5.1 Electrical Injuries, Safe limit of current and voltage, Effects of electric current on human body, 5.2 Static electricity hazards & prevention 5.3 Electrical Hazards at Home and their prevention Safe use of Electric home appliances, 5.4 Electrical Hazards in Offices and Industries 5.6 Safety Devices **Course Outcome- CO5 Teaching Hours – 02**
6	**Introduction of Industrial Safety** 6.1 Classification of Industrial accidents in industries, accident reporting, Record keeping 6.2 Creating Safety awareness, Motivation for safe practices, 6.3 Industrial safety hazards, Occupational Health Hazards : Heat Stress, sound pollution, Vibrations, Temperature etc 6.4 First Aid **Course Outcome- CO1 Teaching Hours – 02**

List of Assignments/ Practical: All assignments/practical are compulsory

Sr. No.	CO	Unit No	List of Experiments	Hours
1	CO1	1	**Assignment on Public & Home Safety**	04
2	CO2	2	**Demonstration of Safe practices while using Hand and power tools** Teacher to demonstrate the safe practices. Student to observe and rehearse the practices. Prepare write up on safe practices while using these tools.	02
3	CO3	3	**Personal safety equipment** Students to collect information regarding various PPE available in market, their specifications and their suitability of application and prepare presentation	04
4	CO4	4	Demonstration of use of Fire extinguisher	04
5	CO5	5	Assignment on Electrical safety	04
6	CO1	6	Demonstration of First Aid Techniques	04
7	CO1 to CO5	All	Visit to Safety exhibition/ safety training institute or Expert lecture by Safety Professional or disaster management expert	04
8	CO1 to CO5	1 to 6	**Mini Project** Students are required to form a group of four. Prepare distribution material on safety Awareness. Arrange one hour safety orientation program for a group of 20 persons like peers, residents of housing societies, school children etc. Prepare a report OR **Case study on Industrial Accident/ Public Place Accident** Using information resources, student has to find out case of General/industrial accident, its effects, causes, what measures could have prevented the accident. Prepare a report on it (Group Activity in 4 students) OR Survey of Institute Laboratories/ Workshop/ Institute building for various hazards	04
			Total	**30**

References/ Books:

Sr. No.	Book Title	Author, Publication, Edition, Year of Publication	ISBN
1	Industrial safety	K.T. Kulkarni, Pune Vidyarthi Grih Prakashan, Pune, 4th Edition, 2012	-
2	Electrical Safety, Fire Safety Engineering and Safety Management	S. Rao, R. K. Jain, H.L.Saluja, Khnanna Publication, 2nd Edition, 1997	978-8174-0930-66
3	Basics of Occupational Safety and Health	Goetsch D.L., Mac Millan, 3rd Edition, 2018	978-0133-4960-79
4	Industrial safety	Blake R.P. ,Prentice Hall,3rd Edition, 2000	978-0134-6313-32

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2. https://ndma.gov.in
3. https://www.gkskill.com
4. www.libertygfg.com
5. https://mospi.nic.in
6. https://safetyskills.com
7. https://dgfscdhg.gov.in
8. www.ehs.princeton.edu

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	1	-	3	2	3	1	2
CO2	1	3	2	1	3	2	3	1	2
CO3	1	3	2	1	3	2	3	1	2
CO4	1	2	2	1	3	2	3	1	2
CO5	1	2	2	1	3	2	3	1	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Ruhil Alwi	Sr. Executive	Coffee Day Beverages, Mumbai
2	Mr. A.S. Sangwikar	Lecturer in Mechanical Engineering	Govt. Polytechnic, Thane
3	Mr. U.A. Agnihotri	Lecturer in Mechanical Engineering	Govt. Polytechnic, Mumbai
4	Mr. E.C. Dhembre	Lecturer in Mechanical Engineering	Govt. Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

P19 Curriculum

Second Semester

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -II**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
SC19102	ENGINEERING PHYSICS	3	2	--	5	5	60	20	20	25*	--	25	**150**
SC19110	ENGINEERING MATHEMATICS	4	--	--	4	4	60	20	20	--	--	--	**100**
ME19209	FUNDAMENTALS OF ELECTRICAL & ELECTRONICS ENGINEERING	3	4	--	7	7	60	20	20	25	--	25	**150**
AM19201	ENGINEERING MECHANICS	3	2	--	5	5	60	20	20	25	--	25	**150**
ME19202	ENGINEERING DRAWING-II	3	3	--	6	6	60	20	20	--	--	50	**150**
ME19401	C PROGRAMMING (Spoken Tutorial)	--	3#	--	3	3	--	--	--	--	--	--	**--**
	Total	**16**	**14**	**--**	**30**	**30**	**300**	**100**	**100**	**75**	**--**	**125**	**700**
	Student Centered Activity (SCA)				**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral,TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, @ indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
Curriculum Development,
Dept. of Mechanical Engineering

Head of Department
Dept. of Mechanical Engineering

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in CE/ ME (Sandwich pattern)**										
Course Code: SC19102				Course Title: **Engineering Physics**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs.30 minutes)	TS1 (1 Hr.)	TS2 (1Hr.)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25***	--	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

The subject is included under the category of science. The special feature of the subject is to develop the laboratory skill using principles of scientific phenomenon. This course will serve to satisfy the need of the technical students for their development in technical field. The course is designed by selecting the topics which will develop intellectual skills of the students and will guide students to solve broad based engineering problems. Ultimately the focus of the course is to develop psychomotor skills in the Students.

Course Outcomes: Student should be able to

CO1	State the different physical quantities identify the proper unit of it and to estimate in the measurement of physical quantities.
CO2	Apply laws of motion in various engineering applications
CO3	Identify the properties of solid , liquid such as elasticity, liquid friction ,viscosity and surface tension
CO4	Analyze types of waves and acoustics of good building.
CO5	Create awareness about the properties and application of light, LASER in engineering field.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Units and Measurements** 1.1 Fundamental Physical quantities, examples. 1.2 Derived physical quantities, examples. 1.3 Definition and requirements of unit 1.4 System of units, C. G. S., M. K. S. and S. I. units. 1.5 Rules to write the unit and conventions of units and Significant figures, rules to write significant figures. 1.6 Error – Definition, types of errors and estimation of errors 1.7 Numerical **Course Outcome: CO1 Teaching Hours : 8 hrs. Marks: 6 (R- 2, U-2, A-2)**
2	**Motions** **2.1 Linear motion** –Definition – distance, displacement, velocity, equation of motions, acceleration due to gravity and under gravity, numerical **2.2** Periodic motions : a)Oscillatory motion, b)Vibratory motion, c) S.H.M d) Circular motion. (only definition and examples), **2.3 Angular motion:** a) Definition: Time period, frequency, amplitude, wavelength, and phase. Uniform circular motion, Radius vector, linear velocity, Angular velocity , Angular acceleration,Numerical. b) Relation between linear velocity and angular Velocity (derivation), Radial or centripetal acceleration, Three equations of motion (no derivations) Centripetal and Centrifugal force, examples and applications. **2.4 Kinetics** 2.4.1 Definition Kinetics , momentum, impulse, impulsive force 2.4.2 Newton's laws of motion with equation 2.4.3 Application of Newton's laws of motion 2.4.4 Definition and unit - work power energy 2.4.5 Work energy principle 2.4.6 Numerical. **Course Outcome: CO2 Teaching Hours :10 hrs. Marks: 10 (R- 2 , U-4 , A-4)**
3	**General Properties of Matter** **3.1 Elasticity:** 3.1.1 Deforming force, restoring force, Elastic, plastic and rigid substances, and their examples. 3.1.2 Definition of elasticity, stress, strain and its types. 3.1.3 Hooke's Law and elastic limit. 3.1.4 Stress - Strain curve, yield point, breaking point. 3.1.5 Young's Modulus, Bulk modulus and Modulus of rigidity

	Definition and relation among them. 3.1.6 Factor of safety. 3.1.7 Applications of elasticity 3.1.8 Numerical. **3.2 Liquid Friction** 3.2.1 Friction liquid, pressure 3.2.2 pressure height relation 3.3.3 Pascal's law, Archimedes' Principle and application of it. **3.3 Viscosity** 3.3.1 Concept and Definition of viscosity, velocity gradient. 3.3.2 Newton's law of viscosity, Co-efficient of viscosity, unit of viscosity 3.3.3 Stokes' law, terminal velocity, derivation of Stokes' formula. 3.3.4 Streamline flow, turbulent flow, critical velocity, examples. 3.3.5 Reynolds' number and its significance. 3.3.6 Applications of viscosity. 3.3.7 Numerical. **3.4 Surface Tension :** 3.4.1 Concept of surface tension. 3.4.2 Adhesive and cohesive forces, examples. 3.4.3 Laplace's Molecular theory of surface tension 3.4.4 Angle of contact, its significance. 3.4.5 Expression for surface tension by capillary rise method. 3.4.6 Effect of impurity and temperature. 3.4.7 Applications of surface tension. 3.4.8 Numerical. **Course Outcome: CO3 Teaching Hours: 12 hrs. Marks: 18 (R- 4 , U- 6 , A- 8)**
4	**Sound and Acoustic** **4.1 Sound Waves :** 4.1.1 Wave motion, types of waves – progressive, longitudinal and transverse waves. 4.1.2 Characteristics of longitudinal and transverse waves and comparison. 4.1.3 Free or natural vibrations and forced vibrations, resonance – definition and examples. 4.1.4 Determination of velocity of sound by resonance method. **4.1.5** Numerical**.** **4.2 Acoustics :** 4.2.1 Definition of echo, reverberation , reverberation time and acoustic 4.2.2 Sabine's formula for reverberation time (no derivation) 4.2.3 Factors affecting acoustics of sound. 4.2.4 Acoustical planning of building. 4.2.5 Numerical. **Course Outcome: CO4 Teaching Hours: 8 hrs. Marks: 10 (R- 2 , U- 4 , A- 4)**

5	**Optics and Optical Fiber** **5.1 Optics :** 5.1.1 Revision of reflection and refraction of light. 5.1.2 Laws of refraction, Snell's law. 5.1.3 Determination of refractive index. 5.1.4 Dispersion, dispersive power, Prism formula (derivation) 5.1.5 Critical angle, Total internal reflection. Examples and applications. 5.1.6 Numerical. **5.2 Optical Fiber :** 5.2.1 Principle of propagation of light through optical fiber. 5.2.2 Structure of optical fiber. 5.2.3 Applications. 5.2.4 Difference between optical fiber cable and electric cable wire **Course Outcome: CO5 Teaching Hours : 4 hrs. Marks: 10 (R- 2 , U- 4 , A- 4)**
6	**LASER** 6.1 LASER introduction, 6.2 Properties of laser, 6.3 Spontaneous and stimulated emission, 6.4 Population inversion, Optical pumping, 6.5 Applications of LASER. **Course Outcome: CO5 Teaching Hours : 3 hrs. Marks: 6 (R- 2 , U- 2 , A-2)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Units and Measurements**	2	2	2	6
2	**Motion**	2	4	4	10
3	**General properties of matter**	4	6	8	18
4	**Sound and Acoustic**	2	4	4	10
5	**Optics and Optical fiber**	2	4	4	10
6	**LASER**	2	2	2	6
	Total	**14**	**22**	**24**	**60**

List of experiments:

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO 1	To know your Physics laboratory and use of scientific calculator.	2
2	1	CO 1	To measure the dimensions of given objects and to determine their Volume using Vernier caliper.	2
3	2	CO 2	To determine Acceleration due to gravity by simple pendulum	2
4	3	CO 3	To determine coefficient of viscosity of liquid by Stokes' method	2
3	3	CO 3	To determine the surface tension of liquid using capillary rise method.	2
6	4	CO 4	To determine velocity of sound by resonance method.	2
7	5	CO 5	To determine refractive index by using pin method	2
8	1	CO 1	To measure the dimensions of given objects and to determine their Volume using micrometer screw gauge.	2
9	2	CO 2	To determine stiffness constant by using helical spring	2
10	3	CO 3	To determine the Young's modulus of elasticity of wire using Young's apparatus	2
11	3	CO 3	To verify the relation between radius of capillary tube and height of liquid in a capillary tube.	2
12	4	CO 4	To determine velocity of sound by using sonometer.	2
13	6	CO 5	Experiment on LASER	2
14	5	CO 5	To demonstrate spectrometer	2
15	ALL	CO 1	Showing Video on different applications related to units,	2
			Total	**30**

Note: Experiments No. 1 to 10 are compulsory and should map all units and Cos. Remaining 5 experiments are to be performing on the importance of topic.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Applied Physics	Manikpure & Deshpande ,S.Chand & Company	10:8121919541 13:9788121919548
2	Applied Physics	B.G.Bhandarkar, Vrinda Publication	0071779795
3	Optics & Optical Fibers	Brijlal Subhramanyan	978-3-662-52764-1
4	Engineering Physics	Gaur and S.L.Gupta S.Chand & Company	0-07-058502
5	Physics	Resnick and Halliday Tata McGraw Hills	978-0-07-1755487-3
6	Physics part I & II	H.C .Varma	9788177091878
7	Properties of Matter	D.S .Mathur	13: 978-8121908153

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1. www. Physics.org
2. www.physicsclassroom.com
3. www.youtube/physics
4. www.ferrofphysics.com
5. http;//hperphysics.phastr.gsu.edu/hbase/hph.htm
6. www.sciencejoywagon.com/physicszone
7. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-physics
8. MYCBSEGUIDE
9. **https://ndl.iitkgp.ac.in/**

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	1	1	2	1	
CO2	3	--	1	---	1	1	1	2	1	1
CO3	3	1	1	---	1	1	1	1	1	
CO4	3	1	1	2	1	1	1	2	1	1
CO5	3	1	1	1	---	---	1	1	---	---

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	1	1	2	1	1	1	2	---
CO2	3	1	1	---	1	1	1	1	1
CO3	3	1	1	---	1	1	1	2	1
CO4	3	---	1	2	1	1	1	2	---
CO5	3	1	1	1	---	---	1	1	---

Industry Consultation Committee:

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1	Mr. Rajesh Masane	Sr. Engineer	L and T Mumbai
2	Mrs B.J. Choudhary	Lecturer in Physics	Govt. Polytechnic Thane
3	Mrs S.A. Thorat	Lecturer in Physics	Govt. Polytechnic Mumbai
4	Dr. D.S. Nikam	Lecturer in Physics	Govt. Polytechnic Mumbai

Coordinator, Head of Departments
Curriculum Development, Department of Sci. & Humanities
Department of Sci. & Humanities

I/C, Curriculum Development Cell Principal

Programme : **Diploma in CE/ME/CO/IF/EC/EE/IS(Sandwich Pattern)**										
Course Code: **SC19110**				Course Title: **ENGINEERING MATHEMATICS**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 Min.)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
4	**--**	**--**	**4**	**60**	**20**	**20**	**--**	---	**--**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR- Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

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Rationale:

This subject is kept under the branch of sciences. This subject intends to teach student basic facts ,concepts, principles, and procedure of mathematics as a tool to analyze engineering problems and as such lays down foundation for understanding the engineering and core technology subject.

Course Outcomes: Student should be able to

CO1	Define the basic principles of function, limits, derivatives, complex number and relations between two variables.
CO2	Apply rules, concept and properties to solve the problems
CO3	Solve the given problems of integration using suitable method.

Course Content Details:

Unit No	Topics / Sub-topics
1	**1. Function** 1.1 Definition of variable,constant,intervals such as open,closed,semi-open etc 1.2 Definition of function,value of function and types of functions and simple examples **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 4, U-4, A-2)**
2	**2. Limits** 2.1 Definition of neighbourhood,concept and definiton of limit 2.2 Limits of Algebraic function 2.3 Limits of Trigonometric Functions with simple examples **Course Outcome: CO1 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U-4 , A-4)**
3	**3. Derivatives & Application of derivative** 3.1 Definition of the derivative. 3.2 Derivatives of standard function.(No proof by first principle) 3.3 Differentiation of sum, difference, product and quotient of two or more functions 3.4 Differentiation of composite function with simple example. 3.5 Second order derivative. 3.6 Geometrical Meaning of Derivative 3.7 Tangents & Normals to the curve, 3.8 Maxima & minima of the function 3.9 Radius of curvature **Course Outcome: CO2 Teaching Hours : 10 hrs Marks:10 (R-4 , U- 4 , A-2)**
4	**4. Integration & Application of integration** 4.1 Definition of integration as antiderivative ,Integration of standard function 4.2 Rules of integration(Integration of sum, difference,scalar multiplication) without proof 4.3 Integration by substitution 4.4 Integration of composite function 4.5 Definiton of definite integral 4.6 Properties of definite integral with simple problems 4.7 Area under the curve 4.8 Area bounded by two curves **Course Outcome: CO3 Teaching Hours :10 hrs Marks:10 (R-4, U- 4 , A-2)**
5	**5. Complex Number:-** 5.1 Definition of complex number Cartesian ,Polar ,Exponential form of complex number 5.2 Algebra of complex number :-Equality , addition ,Substraction ,Multiplication & Division with simple examples **Course Outcome: CO2 Teaching Hours :10hrs Marks:10 (R- 2 , U-4 , A-4)**
6	**6. Numerical Analysis** 6.1 Solution of Algebraic equations using – i) Bisectional method ii) Regular – Falsi method , iii) Newton- Raphson method 6.2 Solution of simultaneous equation (i) Gauss elimination method (ii) Jacobi's method (iii) Gauss-Seidal method **Course Outcome: CO2 Teaching Hours : 10 hrs Marks: 10 (R- 2 , U- 4 , A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Function**	04	04	02	10
2	**Limits**	02	04	04	10
3	**Derivatives & Application of Derivatives**	04	04	02	10
4	**Integration & Application of Integration**	04	04	02	10
5	**Complex Number**	02	04	04	10
6	**Numerical Analysis**	02	04	04	10
Total		**18**	**24**	**18**	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mathematics for Polytechnic Students	S.P.Deshpande, Pune Vidyavardhini Graha Prakashan	-
2	Mathematics for Polytechnic Students (Volume I)	H.K.Dass, S.Chand Prakashan	9788121935241
3	Companions to Basic Maths	G.V.Kumbhojkar, Phadke Prakashan	10-B07951HJDQ 13-B07951HJDQ
4	Applied Mathematics	N.Raghvendra Bhatt late, Tata McGraw Hill Publication Shri R Mohan Singh	9789339219567, 9339219562

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2. www.Scilab.org/-SCI Lab
3. www.mathworks.com/Products/Matlab/-MATLAB
4. www.wolfram.com/mathematica/-Mathematica
5. https://www.khanaacademy.org/math?gclid=CNqHuabCys4CFdoJaAoddHoPig
6. www.dplot.com/-Dplot
7. www.allmathcad.com/-Math CAD
8. www.easycalculation.com
9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	1		1
CO2	3			1			1	1		1
CO3	3			1			1	1		1

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3			1			1	1	
CO2	3			1			1	1	
CO3	3			1			1	1	

CO Vs PO and CO Vs PSO Mapping (COMPUTER ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	1	1	
CO2	3			1			1	1	1	
CO3	3			1			1	1	1	

CO Vs PO and CO Vs PSO Mapping (INFORMATION TECHNOLOGY)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	1		1
CO2	3			1			1	1		1
CO3	3			1			1	1		1

CO Vs PO and CO Vs PSO Mapping (ELCTRONICS ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1		1	1
CO2	3			1			1		1	1
CO3	3			1			1		1	1

CO Vs PO and CO Vs PSO Mapping (ELECTRICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1		1	
CO2	3			1			1		1	
CO3	3			1			1		1	

CO Vs PO and CO Vs PSO Mapping (INSTRUMENTATION ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3			1			1	1	1
CO2	3			1			1	1	1
CO3	3			1			1	1	1

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Neelamkumar R. Sawant	State Head Technical Services for (Maharashtra and Goa)	JSW Cement ltd. Mumbai Head Office
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3	Mr. A.S.Patil	Lecturer in Mathematics	Government polytechnic Mumbai
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Coordinator,
Curriculum Development,
Department of Sci. & Humanities

Head of Departments
Department of Science & Humanities

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: **ME19209**				Course Title: **Fundamentals of Electrical and Electronics Engineering**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**4**	**--**	**7**	**60**	**20**	**20**	**25**	**-**	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

This is the subject where the principles of electrical energy are studied. Knowledge of basics of electrical is essential to apply on all type of electrical machines, instruments, devices and equipment's. The basic aim of this course is that, the student must learn basic concepts, rules and laws of electric and magnetic circuits and practical's. The knowledge of this course will be useful for other higher-level subject

Course Outcomes: Student should be able to

CO1	Apply basic concepts of electrical engineering
CO2	Analyze performance of single-phase transformer
CO3	Select electric machine for specific application.
CO4	Describe the fundamentals of Diode and their applications
CO5	Illustrate the basic fundamentals, biasing techniques and applications of transistor
CO6	List types of power devices and their applications

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basic Concept** 1.1 Concept of Electric current, Electric Potential, Potential difference, E.M.F. Difference between E.M.F and Potential Difference 1.2 Resistance, factors affecting Resistance, Effect of Temperature on Resistance. Temperature Co-efficient of Resistance 1.3 Classification of Electric Current, compare DC with AC 1.4 Effects of Electric Current. 1.5 Concept of Electrical Work, Power & Electrical energy (Simple Problems) 1.6 Equation for equivalent resistance connected in i) series ii) parallel 1.7 Concept of current, voltage, phasor relationship of current and voltage, waveform of pure resistance, pure inductance and pure capacitance 1.8 Concept of Power and power factor

	1.9 Power triangle: Active power, Reactive power, Apparent power 1.10 Magnetic circuit, Magnetic flux, properties of magnetic lines of force, magnetic flux density 1.11 Faraday's Laws of Electromagnetic Induction. 1.12 Direction of induced E.M.F i) Fleming Right Hand Rule ii) Lenz's Law 1.13 Types of Induced E.M.F. Self & mutual Induction (no numerical) **Course Outcome: CO1 Teaching Hours:12 Marks: 12 (R-2 , U-6,A-4)**
2	**Transformer** 2.1 Working Principal of transformer. 2.2 Construction of Single phase Transformer and types of transformer depending on construction and transformation ratio. 2.3 EMF equation(No derivation):voltage ratio, Turns ratio Transformation ratio 2.4 Transformer losses, Efficiency and regulation of transformer 2.5 specification & application of transformer 2.6 Three phase transformer: types of three phase transformer depending on connection. 2.7 Comparison between single phase and three phase transformer 2.8 Construction and working of Welding transformer **Course Outcome: CO2 Teaching Hours : 8 Marks: 7(R- 2 , U- 3 , A- 2)**
3	**Induction Motor** 3.1 Working principle. 3.2 3ph Squirrel cage induction motor – construction, application 3.3 Slip Ring Induction motor – construction, application 3.4 Synchronous speed, % slip [simple problems] 3.5 Starting of 3 ph induction motor i) DOL ii) Star Delta iii) Reduced voltage iv) Rotor resistance starter 3.6 Torque – Slip characteristics, Rating and Specification of three phase induction motor. 3.7 Speed control: Voltage control, Rotor resistance control & frequency control 3.8 Reversal of Induction Motor 3.9 Single phase Induction motor : Types only 3.10 Comparison between three phase and single phase Induction Motor **Course Outcome: CO3 Teaching Hours :10 Marks:11(R-2 , U-5, A-4)**
4	**Diode application** 4.1 PN junction diode: Forward and reverse bias. 4.2 Review of Transformer: Step Up, Step down. 4.3 Rectifier: Definition, Types, Circuit diagram, waveforms and Working of a) Half wave rectifier (b) Full Wave rectifier (Centre Tapped) (c) Full wave Bridge rectifier. **CourseOutcome:CO4 Teaching Hours:4 Marks:10 (R-2, U-4, A-4)**

5	**Transistor Fundamentals and applications** 5.1 Bipolar Junction Transistor: Symbol, Construction and working of PNP and NPN transistors. BJT biasing: Introduction: Need of biasing, DC Operating point and load line, factors contributing to thermal instability, Effect of temperature (Thermal runway), Stability Factor **5.2** Voltage divider bias Application of Transistor**:** 5.3 Transistor as a Switch. 5.4 Single stage Common Emitter (CE) amplifier (circuit diagram and working) and its frequency response. **Course Outcome:CO5 Teaching Hours:7 Marks:12(R-2, U-6, A-4)**
6	**Power devices** 6.1 Construction, symbol, characteristics and application of SCR, TRIAC and DIAC. 6.2 Relay : symbol , contacts , construction , working , applications of general purpose relay. **Course Outcome:CO6 Teaching Hours:4 Marks: 08(R-2, U-6, A-0)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basic Concept	2	6	4	12
2	Transformer	2	3	2	7
3	Induction Motor	2	5	4	11
4	Diode application	2	4	4	10
5	Transistor Fundamentals and applications	2	6	4	12
6	Power devices	2	6	--	08
	Total	12	30	18	60

List of experiments for Electrical Engineering: Any 10 experiments out of 13

Sr. No.	Unit No	CO	List of Experiments	Hours
1	1	CO1	Use of Multimeter for measurement of AC & DC voltage, resistance, continuity	2
2	2	CO2	Measure the voltage ratio and transformation ratio of transformer	2
3	3	CO3	To measure slip of 3-phase induction motor.	2
4	1	CO1	To measure current, voltage, power and energy in single-phase circuit	2

Sr. No.	Unit No	CO	List of Experiments	Hours
5	2	CO2	To verify efficiency and regulation of transformer	4
6	3	CO3	To plot speed Torque characteristics of 3- phase induction motor	2
7	1	CO1	Measure voltages and currents in series and parallel resistive circuit.	4
8	1	CO1	To verify effect of temperature on resistance of conductor.	2
9	2	CO2	Prepare a report on types of three phase transformer depending on connection.	2
10	3	CO3	To use different types of starter to start and run three phase Induction motor. i) DOL Starter ii) star delta starter iii) Rotor resistance starter	2
11	1	CO1	To verify Faraday's First Law of electromagnetic Induction (For Dynamically & Statically Induced EMF)	2
12	2	CO2	Demonstration and Study of Welding Transformer	2
13	3	CO3	To reverse the direction of three phase Induction motor.	2
		Total		**30**

List of experiments for Electronics Engineering:

Sr. No.	Unit No	CO	List of Experiments	Hours
1	4	CO4	To plot the V-I characteristic of semiconductor P-N diode.	4
2	5	CO5	To construct transistor as switch and Observe input and output waveforms.	4
3	6	CO6	To plot the V-I characteristic of SCR	4
4	4	CO4	To observe the waveform of half wave rectifier.	2
5	4	CO4	To observe the waveform of full wave Centre tapped rectifier	2
6	4	CO4	To construct and observe the waveform of full wave bridge rectifier	2
7	5	CO5	To plot input and output characteristics of BJT in CE mode	4
8	5	CO5	To draw a frequency response of Single stage Common Emitter amplifier	4
9	6	CO6	To test the phase control / light dimmer circuit using SCR	4
			Total	**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Electrical Technology (Volume I and II)	B.L. Theraja, A.K. Thereja S. Chand and Co. Ltd. , 23rd Ed,, 1959	978-8121-9244-05 978-8121-9243-75
2	Basic Electrical Engineering	V. K. Mehta, Rohit Mehta, S. Chand and Co. Ltd., Revised Ed. 2006	978-8121-9087-19
3	Electronics Principles	Malvino, Albert Paul, David, McGraw Hill Education, 7th edition ,1 July 2017	978-0070634244
4	Principles of Electronics	Mehta V.K., Mehta Rohit , S. Chand and Company, 7th Ed, 2014	978-8121-9245-04
5	Fundamentals of Electronic Devices and Circuits	Bell, David ,Oxford University Press, 5th Ed., 2007	978-0195-4252-39
6	A text book of Applied Electronics	Sedha R.S, S.Chand & Co., 3rd Ed, 2008	978-8121-9278-33

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- www.electrical4u.com
- www.khanacademy.org
- https://ndl.iitkgp.ac.in/
- www.electronicshub.org/tutorials/
- www.tutorialspoint.com/
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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	--	2	2	--	3	3	3
CO2	3	3	--	2	2	--	3	3	3
CO3	3	3	--	2	2	--	3	3	3
CO4	3	2	2	-	-	-	2	3	3
CO5	2	2	-	1	-	-	1	3	3
CO6	2	-	2	1	-	-	2	3	3

Industry Consultation Committee:

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2	Mr.Prahant Hiremat	Senior Engineer	Reliance Industries, Navi Mumbai
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4	Miss A.V. Patil	Lecturer in Electrical Engineering	Govt. Polytechnic Mumbai
5	Mrs.Puri Sanyogeeta B.	Lecturer in Electronics Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Civil Engineering & Mechanical Engineering (Sandwich Pattern)**										
Course Code:**AM19201**				Course Title: **Engineering Mechanics**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
03	**02**	**--**	**05**	**60**	**20**	**20**	**25**	**--**	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale :

In day to day life we come across different structures, at the time of design of structures, analysis plays an important role. Perfect analysis is possible only when one knows the types and effect of forces acting on the structure. This course provides knowledge about the different types of forces/loads, their effects while acting in different conditions/systems. The course also provides the knowledge about basic concepts of laws of engineering, their application to different engineering problem. The principles of mechanics are fundamental to Mechanical and Civil Engineering and related programs such as Mechatronic Engineering, Naval Architecture, Aerospace, Manufacturing as well as Biomedical engineering. This course is needed as a prerequisite for the courses at higher level such as Mechanics of Structures, Strength of Materials, Design of Structures, Theory of Machines, etc.

Course Outcomes: Student should be able to

CO1	Apply principles of simple machines.
CO2	Determine unknown forces of various force system.
CO3	Apply the principles of equilibrium to engineering problems.
CO4	Apply the principle of friction in various conditions.
CO5	Calculate centroid and center of gravity for various geometrical figures.
CO6	Apply the principles of dynamics.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Simple Machines:** 1.1 Definitions 1.2 Simple machine, compound machine , load , effort , mechanical advantage , velocity ratio , input of a machine ,output of a machine efficiency of a machine , ideal machine,

	ideal effort and ideal load, load lost in friction, effort lost in friction 1.3 Analysis: Law of machine, maximum mechanical advantage and maximum efficiency of a machine, reversibility of a machine, condition for reversibility of a machine, self-locking machine, simple numerical problems. 1.4 Velocity Ratio for simple machines : Simple axle and wheel, differential axle and wheel, Weston's differential pulley block, single purchase crab, double purchase crab, worm and worm wheel, geared pulley block, screw jack, calculation of mechanical advantage, efficiency, identification of type such as Reversible or not etc. **Course Outcome: CO1 Teaching Hours : 6 hrs Marks: 12 (R- 2, U-4, A-6)**
2	**Force systems:** 2.1 Fundamentals and Force systems: Definitions engineering mechanics, statics, Dynamics. Classification of force system according to plane coplanar and non-coplanar, sub classification of coplanar force system-collinear, concurrent, non-concurrent, parallel, Definition of a force, representation of a force by vector and by Bow's notation method. Characteristics of a force, effects of a force, principle of transmissibility. 2.2 Resolution of a force and Moment of a force: Definition, Method of resolution, along mutually perpendicular direction and along two given direction. Definition of moment, classification of moments, sign convention, law of moments, Varignon's theorem of moment and it's use, definition of couple, properties of couple 2.3 Composition & resolution of forces : Definition of Resultant force, methods of composition of forces, Law of parallelogram of forces, Algebraic method for determination of resultant for various force system. 2.4 Graphical method: Space diagram, vector diagram, polar diagram, and funicular polygon. Resultant of concurrent and parallel force system only. **Course Outcome: CO2 Teaching Hours: 10 hrs Marks: 12 (R -4, U- 4, A- 4)**
3	**Equilibrium**: 3.1 Equilibrant and Lami's Theorem: Definition of equilibrant, relation between resultant and equilibrant, equilibrant of concurrent and non-concurrent force system. Analytical, free body and free body diagram. Statement and explanation of Lami's theorem and Application. 3.2 Beams: Definition, Types of beams (cantilever, simply supported, overhanging, fixed, continuous), Types of end supports (simple support, hinged, roller), classification of loads, point load, inclined point load, uniformly distributed load. Analytical method to determine reactions of simply supported, cantilever and over hanging beam subjected to point loads and UDL and graphical method to determine reactions for beams subjected to vertical point loads & UDL only **Course Outcome: CO3 Teaching Hours:8 hrs Marks: 10 (R- 2, U- 4, A- 4)**

4	**Friction:** 4.1 Definition: Friction, Types of friction, limiting frictional force, coefficient of friction, angle of friction, angle of repose, relation between angle of friction, angle of repose and coefficient of friction. Cone of friction, advantages and disadvantages of friction. 4.2 Equilibrium of body on Horizontal and inclined plane: Equilibrium of body on horizontal plane subjected to horizontal and inclined force. Equilibrium of body on inclined plane subjected to forces applied parallel to the plane only. Concept of ladder friction. 4.3 Introduction (only) - Dynamic friction **Course Outcome: CO4 Teaching Hours: 8 hrs Marks: 10 (R- 2 ,U- 4, A- 4)**
5	**Centroid and Centre Of Gravity:** 5.1 Centroid: Definition of centroid. Moment of an area about an axis. Centroid of basic geometrical figures such as square, rectangle, triangle, circle, semicircle and quarter circle. Centroid of composite figure with not more than three geometrical figures. 5.2 Center of gravity: Definition, center of gravity of simple solids such as cylinder, sphere, hemisphere, cone, cube, and rectangular block. Centre of gravity of composite solids with not more than Two simple solids. (Hollow solids are expected.) **Course Outcome: CO5 Teaching Hours: 8 hrs Marks: 10 (R- 2, U- 2, A- 6)**
6	**Dynamics :** 6.1 Kinetics : Definition of kinetics, Newton's laws of motion and its applications. 6.2 Kinematics : Definition of kinematics, Basic concepts of motion, rectilinear motion, displacement, velocity, speed, acceleration. 6.3 Angular motion : Introduction, definition of angular velocity, angular acceleration, angular displacement, (Simple Numericals) 6.4Motion under gravity. (No numerical on this subtopic) **Course Outcome: CO6 Teaching Hours: 5 hrs Marks: 6 (R-2, U- 0, A- 4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Simple Machines	2	4	6	12
2	Force Systems	4	4	4	12
3	Equilibrium	2	4	4	10
4	Friction	2	4	4	10
5	Centroid and Centre Of Gravity	2	2	6	10
6	Dynamics	2	--	4	6
	Total	**14**	**18**	**28**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	01	CO1	To determine MA, VR, Efficiency, Ideal Effort, Effort lost in friction for Differential axle & wheel and for Simple screw jack.	02
2	01	CO1	To determine MA, VR, Efficiency, Ideal Effort, Effort lost in friction for single purchase crab and for double purchase crab.	02
3	02	CO2	Verify law of polygon of forces	02
4	02	CO2	Graphically determine resultant of concurrent and non-concurrent force system.	04
5	02	CO2	Graphically determine resultant of parallel force system.	02
6	02	CO2	To verify law of moments.	02
7	03	CO3	To verify of Lami's theorem	02
8	03	CO3	To verify the Equilibrium of parallel forces – simply supported beam reactions	02
9	04	CO4	To determine coefficient of friction for motion on horizontal plane.	04
10	05	CO5	Determination of Centroid of basic geometrical figures such as square, rectangle, triangle, circle & Centre of gravity of simple solids such as cylinder, sphere, cone, cube.	04
11	06	CO6	Numericals on Angular motion	04
		Total		**30**

Note: All experiments are compulsory

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering Mechanics	R.S.Khurmi, S. Chand & Company Ltd.	10-9352833961
2	Engineering Mechanics	Shames and Rao, Pearson Education.	13-978-0133569087
3	Engineering Mechanics	R.C.Hibbeler, Pearson Education.	13-978-0133073577
4	Applied Mechanics	S. Ramamruthum, Dhanpat Rai & Sones, Delhi.	10-935216427X

E-References:

1. support@swayam.gov.in
2. arunasis@iitg.ernet.in
3. www.google.com
4. www.youtube.com
5. http://www.nationallibrary.gov.in

CO Vs PO and CO Vs PSO Mapping (CIVIL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	2	3	2	--
CO2	3	3	3	2	1	1	2	3	--	--
CO3	3	3	3	2	1	1	2	3	--	--
CO4	3	3	3	2	1	1	2	3	--	--
CO5	3	3	3	2	1	1	2	3	--	--
CO6	3	3	3	2	1	1	2	3	--	--

CO Vs PO and CO Vs PSO Mapping (MECHANICAL ENGINEERING)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	2	1	2	2	3	2
CO2	3	3	3	2	1	1	2	3	3
CO3	3	3	3	2	1	1	2	3	3
CO4	3	3	3	2	1	1	2	3	3
CO5	3	3	3	2	1	1	2	3	3
CO6	3	3	3	2	1	1	2	3	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Shri Shivkumar Aade	Deputy Chief Engineer	Mhada
2	Shri Sharad Sonawane	Director	Om Ajay Constructions
3	Smt Yaxika Soni	Sr.Lecturer in Civil Engineering	S.B.M.Polytechnic
4	Smt Sanjana Male	Lecturer in Civil Engineering	G.P.Mumbai
5	Smt Ashwini Hagawane	Lecturer in Mechanical Engineering	G.P.Mumbai

Coordinator,
Curriculum Development,
Department of Civil Engineering

Head of Department
Department of Civil Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19202				Course Title: Engineering Drawing-II						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (3Hrs 30 min)	TS1 (1Hr 30 min)	TS2 (1Hr, 30 min)	PR	OR	TW	Total
3	**3**	**--**	**6**	**60**	**20**	**20**	**--**	--	**50**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination.
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Engineering drawing is the graphical language of Engineers. This is a graphical tool used by the Designers, Planners, Supervisors and Technician to express their thoughts, ideas and concepts. It offers students an insight into the methods of dealing with engineering drawing problems. This preliminary course aims at building a foundation for further course in machine drawing and other allied subjects. This subject is useful in developing imagination, drafting and sketching skills of students.

Course Outcomes: Student should be able to

CO1	Draw the projection of different models of regular solids.
CO2	Draw the projection of different cut models of regular solids.
CO3	Draw the development of lateral surfaces for different solids.
CO4	Draw Curves of intersection of the surfaces of different solids.
CO5	Draw the missing views and sectional missing views.
CO6	Draw the auxiliary views of different objects.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Projection of Solids** 1.1 Projections of Prism, Pyramid, Cone, Cylinder, Tetrahedron, Cube with their axes inclined to one reference plane and parallel to other. 1.2 Projections of above solids using auxiliary plane method **Course Outcome: CO1 Teaching Hours :06 Marks: 06 (R-0, U-0, A-6)**
2	**Sections of Solids** Draw the sectional views for a cutting plane parallel to one perpendicular to other plane 2.1 Cone, Pyramid, Prism & Cylinder resting on their base on Horizontal Plane.

	2.2 Prism, Cylinder: a) Axis parallel to both the reference plane. b) Axis perpendicular to and parallel to other plane **Course Outcome:CO2 Teaching Hours:08 Marks: 12(R-0, U-0, A-12)**
3	**Developments of Surfaces** 3.1 Draw the development of lateral surfaces of cube, prism, cylinder, pyramid and cone 3.2 Development of surfaces such as tray, funnel, Chimney and pipe bends. **Course Outcome:CO3 Teaching Hours :09 Marks: 12(R-0, U-0, A-12)**
4	**Intersection of solids** 4.1 Prism with prism, Cylinder with cylinder, Prism with Cylinder When (i) the axes are at 90° and intersecting (ii) The axes are at 90° and Offset. and cone resting on base on HP and with axis intersecting and offset from axis of cylinder. **Course Outcome:CO4 Teaching Hours : 06 Marks:08 (R-0, U-0, A-08)**
5	**Missing views** 5.1 Draw the missing view for a given orthographic views 5.2 Draw the sectional missing view for a given orthographic views **Course Outcome:CO5 Teaching Hours : 08 Marks:10 (R-0, U-0, A-10)**
6	**Auxiliary views** 6.1 Concept of auxiliary plane 6.2 Projection of object on auxiliary plane 6.3 Completing the auxiliary views with the help of given views **Course Outcome:CO6 Teaching Hours :08 Marks:12 (R-0, U-0, A-12)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Projection of Solids	0	0	06	06
2	Sections of Solids	0	0	12	12
3	Developments of Surfaces	0	0	12	12
4	Intersection of solids	0	0	08	08
5	Missing views	0	0	10	10
6	Auxiliary views	0	0	12	12
	Total	**0**	**0**	**60**	**60**

List of Drawing Sheets

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Sheet No:1 Projection of Hexahedron/pyramid/prism /cone (one problem)	02
2	2	CO1	Sheet No:1 Projection of Hexahedron/pyramid/prism /cone with auxiliary method (one problem)	02
3	3	CO2	Sheet No:2 Sections of Solids such as cone/pyramid/cylinder/prism when true shape of the section is given (one problem)	04
4	4	CO2	Sheet No:2 Sections of Solids such as cone/pyramid/cylinder/prism when cutting section is given (one problem)	04
5	5	CO3	Sheet No:3Developments of Surfaces such as cone/pyramid/cylinder/prism when cutting section is given (one problem)	04
6	6	CO3	Sheet No:3 Developments of Surfaces such as Tray/ Elbow/Pipe Joints (one problem)	04
7	1	CO4	Sheet No:4 Intersection of solids interpenetrating solid intersecting their axis such as prism with prism or cylinder with cylinder or cone with cylinder (Two problems)	04
8	2	CO4	Sheet No:4Intersection of solids interpenetrating solid with offset in their axis such as prism with prism or cylinder with cylinder or cone with cylinder (Two problems)	05
9	3	CO5	Sheet No:5Missing views (Two problems)	04
10	4	CO5	Sheet No:6Missing sectional views (Two problems)	04
11	5	CO6	Sheet No:7Auxiliary views (Two problems)	04
12	6	CO6	Sheet No:8 Complete the Top view/ Front view when auxiliary view is given (Two problems)	04
Total				**45**

Note: All Sheets are compulsory.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering drawing	N.D.Bhatt, Charotar Publishing House, 53rd Edition, 2016	978-9380-3581-78
2	Engineering Graphics	P.J. Shah, S. Chand, revised edition,2014	978-8121-9296-79
3	Engineering Drawing	Amar Pathak, Wiley Publication,1st Ed. 2010	978-9350-0401-64
4	Engineering drawing	D.Jolhe, Tata McGraw Hill Education,2017	978-0070-6483-71

5	Textbook on engineering drawing	K.L.Narayan,P.Kannaiah, Scitech publications, 24th reprint, 2010,	978-8183-7142-28
6	Engineering drawing practice For school and colleges	IS Code SP-46	-

E-References:

1. https://ocw.mit.edu.courses.drawing
2. https://nptel.in.courses.drawin
3. http://home.iiik.edp.ac.in

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	02	01	01	01	01	01	02	01	01
CO2	02	01	01	01	01	01	02	01	01
CO3	03	01	02	01	01	01	03	01	01
CO4	03	01	02	01	01	01	03	01	01
CO5	02	01	02	01	01	01	03	01	01
CO6	02	01	02	01	01	01	03	01	01

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Mr. Kiran Pawar	Managing Director	Seven star solar system Ltd
2	Mr. K.B. Salunkhe	Sel. Grade Lecturer in Mechanical Engineering	Government Polytechnic,Thane
3	Dr. S. B. Mahagaonkar	Sel. Grade Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
4	Mr. K. Z. Dhangare	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
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Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

P19 Curriculum

Third Semester

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -III**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19203	MANUFACTURING PROCESSES	2	4	--	6	6	60	20	20	25*	--	25	**150**
ME19210	STRENGTH OF MECHANICAL MATERIALS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19205	BASIC THERMODYNAMICS	2	2	--	4	4	60	20	20	--	--	25	**125**
ME19206	THEORY OF MACHINES	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19301	MACHINE DRAWING & COMPUTER AIDED DRAFTING	--	4	--	4	4	--	--	--	25*	--	25	**50**
ME19207	FLUID MECHANICS AND MACHINERY	2	2	--	4	4	60	20	20	--	--	25	**125**
ME19103	ENVIRONMENTAL STUDIES	--	2#	--	2	2	--	--	--	--	--	--	**--**
	Total	**12**	**18**	**--**	**30**	**30**	**300**	**100**	**100**	**50**	**--**	**150**	**700**
	Student Centered Activity (SCA)				**05**								
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral,TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, @ indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# Indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
Curriculum Development,
Dept. of Mechanical Engineering

Head of Department
Dept. of Mechanical Engineering

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME 19203				Course Title: Manufacturing Processes						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
2	4	--	6	60	20	20	25*	--	25	150

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at mid-term and second skill test at the end of the term.

Rationale:

Manufacturing is the basic area for any mechanical engineering technician. The technician should be exposed to basic manufacturing processes. This course will help the student to get familiarized with working principle and operation like turning, drilling, milling, casting, and joining processes etc. Basic knowledge of these processes will help the technician to select most appropriate process for getting the desired results in terms of getting raw material converted in to finish product, as per the requirement.

Course Outcomes: Student should be able to

CO1	Describe basic foundry procedures
CO2	Describe sheet metal presses and press operations
CO3	Describe basic joining processes and their applications
CO4	Describe construction and various operations carried out using lathe and boring machine
CO5	Describe constructional features, types of milling machines and drilling machines and operations using them
CO6	Describe grinding machines, operations performed using them and surface treatment processes

Course Content Details:

Unit No	Topics / Sub-topics
1	**Foundry Practice:** 1.1. Pattern materials, types of patterns, pattern allowances, color coding, moulding tools and equipment, 1.2. Moulding sands, types of sands, sand properties, 1.3. Elements of sand moulds, Machine molding, 1.4. Permanent mould casting-Gravity & Pressure Die casting, 1.5. Cupola furnace, defects in castings and remedies, 1.6. Safety precautions in foundry **Course Outcome: CO1 Teaching Hours :04 Marks: 08 (R- 0, U-4, A-4)**

2	**Press Working:** 2.1 Types of presses, press specification, parts of press, press classification, 2.2 Press tools: dies and punches, Press operations, Elements of press tool, 2.3 Safety while working in press shop **Course Outcome: CO2, Teaching Hours :04 Marks: 06 (R- 0, U-2, A-4)**
3	**Joining Processes:** 3.1 Principle of welding processes, Classification of welding processes, 3.2 Arc welding- Welding machines, Contents of electrodes for arc welding, manual arc welding, TIG/MIG welding, Submerged arc welding, hydrogen arc welding, 3.3 Gas welding set up for oxy acetylene welding, types of flames, their applications, 3.4 Resistance welding- Spot, seam, projection, butt resistance welding, 3.5 Defects in welding and their causes. 3.6 Brazing and soldering-process & applications, 3.7 Safety precautions in joining processes. **Course Outcome: CO3 Teaching Hours :04 Marks: 08 (R- 2,U-2, A-4**
4	**Lathe Machines:** 4.1 Centre lathe specification, different parts. Lathe classification, 4.2 Lathe operations: turning, boring, parting off, knurling, facing, drilling, taper turning, thread cutting. 4.3 Single point cutting tool geometry, 4.4 Safety precautions while working on lathe **Course Outcome: CO4 Teaching Hours :04 Marks: 08 (R- 2, U-4, A-2)**
5	**Milling machine:** 5.1 Milling machines classification, different parts of Column and Knee type milling machine, 5.2 Milling machine operations. 5.3 Down milling, up milling, plain milling cutter, 5.4 Gear cutting with simple indexing 5.5 Safety precautions while working on milling machines **Course Outcome: CO5 Teaching Hours :04 Marks: 08 (R-2, U-4,A-2)**
6	**Drilling machines:** 6.1 Classification of drilling machines, 6.2 Different parts of Radial drilling machine and Column type drilling machine, 6.3 Drilling machine operations. 6.4 Twist drill nomenclature, 6.5 Safety precautions while working on drilling machines **Course Outcome: CO5 Teaching Hours :04 Marks: 08 (R-2, U-4, A-2)**

7	**Boring Machines:** 7.1 Classification of boring machines, Different parts of horizontal boring machine, specification of boring machine. 7.2 Operations of boring machine, 7.3 Boring head, facing head, boring tools, 7.4 Safety precautions while working on boring machine **Course Outcome: CO4 Teaching Hours :04 Marks: 06 (R-2, U-2, A-2)**
8	**Grinding Machines and Surface Treatments** 8.1 Classification of grinding machines, 8.2 Grinding machine operations, 8.3 Grinding wheel: abrasives, grit, bond, grades, structure, and grinding wheel specification. 8.4 Safety precautions while working on grinding machine. 8.5 Surface Treatment, Need of surface treatment, Surface anodizing, Cadmium coating, Galvanizing, 8.6 Safety precautions in surface treatments **Course Outcome: CO6 Teaching Hours :04 Marks: 08 (R-2, U-2, A-4)**

Suggested Specifications Table (Theory)

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Foundry Practice**	-	4	4	8
2	**Press Work**	-	2	4	6
3	**Joining Processes**	2	2	4	8
4	**Lathe Machine**	2	4	2	8
5	**Milling Machine**	2	4	2	8
6	**Drilling Machine**	2	4	2	8
7	**Boring Machine**	2	2	2	6
8	**Grinding Machine**	2	2	4	8
	Total	**12**	**24**	**24**	**60**

List of Practicals:

Sr. No.	Unit No	List of Experiments	CO	Hours
1	1	Making one wooden pattern	CO1	8
2	1	Making one simple job on moulding	CO1	6
3	2	One simple job on press	CO2	4
4	3	Making a simple job on welding joint	CO3	6
5	4	One plain turning job on center lathe	CO4	6
6	4	One job on thread cutting, chamfering, filling on centre lathe	CO4	8
7	4	One job on step turning, taper turning on lathe	CO4	8
8	5	One job of gear cutting on milling machine and lathe	CO5	8
9	8	Tool grinding practice	CO6	6
		Total		60

Instructions:

- **A specimen job is to be prepared and demonstrated by concerned workshop instructor before giving job to the students.**
- **Students will maintain a diary containing the details of the job as above.**
- **Theory contents are to be taught by faculty /workshop superintendent.**
- **Term end practical examinations on one of above machines for three hours duration**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Introduction to Manufacturing Processes	Jhon Schey, Mcgraw Hills, 2012	978-0071-1691-10
2	A course in of Workshop Technology Volume. I	B S Raghuwanshi, Dhanpatrai & Sons, 2017	978-1020092015
3	Elements of Workshop Technology Vol. II (Machine Tools)	Hajra Chawdhury, Media Promotors and Publications Pvt. Ltd. 15th Ed, 2008	978-8185099156
4	Elements of Workshop Technology Vol. I (Manufacturing Processes)	Hajra Chawdhury, Media Promotors and Publications Pvt. Ltd. 15th Ed, 2008	978-8185099149

E-References:

- www.engineeringpractice.org>lathe
- www.hnsa.org>wp-contents
- www.learmmechanical.com>drillingmachine
- www.americanamchinist.com>article>cuttingtools
- www.theengineerspost.com>broachingmachine www.reliance-foundry.com
- www.eskaymachine.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	2	1	2	2	3	3
CO2	2	2	2	1	1	2	2	2	3
CO3	3	2	2	2	1	3	2	2	2
CO4	3	2	2	3	2	3	2	3	3
CO5	2	2	2	3	2	2	2	2	2
CO6	1	2	2	2	1	1	2	1	2

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Hiremath P.	Sr. Engineer	Reliance Industries, Navi Mumbai
2	Mr. Rao V B	Asst. Professor	Fr. C.R.C. Engg, Mumbai
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	Mr. Joshi S. V.	Lecturer in Mech. Engg.	Govt. Polytechnic, Mumbai
	Mr. Ansari N N	Lecturer in Mech. Engg.	Govt. Polytechnic, Mumbai

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Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: **ME19210**				Course Title: **Strength of Mechanical Materials**						
Compulsory / Optional: Compulsory subject										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs. 30 min)	TS1 (1 Hr.)	TS2 (1 Hr.)	PR	OR	TW	Total
3	2	-	5	60	20	20	-	-	25	125

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid-term and second skill test at the end of the term.

Rationale: Diploma holders in this course are required to analyse reasons for failure of different components and select the required materials for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles to the solution of applied problems to develop the required competencies.

Course Outcomes: Student should be able to

CO1	Analyze/compare various mechanical properties and develop theoretical basics for axial loading, bending and buckling.
CO2	Calculate principal stresses using analytical and graphical Mohr's circle diagram
CO3	Solve moment of inertia for different sections, section modulus and bending stress.
CO4	Draw shear force diagram & bending moment diagram and calculating slope/deflection for the structural components subjected to lateral loading.
CO5	Analyze direct/bending stresses, Eccentric and Buckling load.
CO6	Evaluate strain energy stored in the element subjected to gradual/sudden/impact loads and numerical on torsional shear stress

Course Content Details:

Unit No	Topics / Sub-topics
1	**Mechanical Properties of Materials, Simple stresses & Strains** 1.1 Types of loads, Simple stresses & strains viz. tensile, compressive, Shear, Crushing, Thermal stresses, Hoop stresses & corresponding strains, Volumetric Strain, Bulk modulus, Hook's law, Young's modulus, Modulus of Rigidity, stress-strain curves for ductile & brittle materials, Poisson's ratio. 1.2 Concepts of Buckling – Rankine's & Euler's formulae for buckling load for columns / shafts under compression, concepts of equivalent length for various end conditions. (Problems on compressive & tensile stresses, Thermal stresses, butt & lap riveted joints, simple cases of buckling). 1.3 Concepts of Deflection & slope of beams – relation between bending moment & slope. Deflection of simply supported beams and cantilever beams subjected to point load. (No derivation) **Course Outcome: CO1, Teaching Hours: 8 Marks: 10(R-2, U-4, A-4)**
2	**Principal planes & Principal stresses** **2.1** Concept of principal planes & stresses. Definition of principal planes, principal stresses, oblique plane and obliquity. **2.2** Different states of stresses, normal & tangential stress on oblique plane, resultant stress. **2.3** Analytical and graphical method (Mohr's Circle) for locating principal plane and calculating principal stresses for uniaxial/biaxial loading. **Course Outcome: CO2 Teaching Hours : 6 Marks: 10 (R-2, U-4, A-4)**
3	**Moment of Inertia & Bending stresses** 3.1 **Moment of Inertia** 3.1.1 Moment of Inertia (M I): M.I. for plane areas, radius of gyration, M.I for regular plane areas 3.1.2 Rectangle, triangle, circle, semi-circle, hollow rectangular and hollow circular section. 3.1.3 Parallel axes theorem & Perpendicular axes theorem (no derivation) 3.1.4 M.I of symmetrical and unsymmetrical I sections, channel and angle sections and T section. M.I of built up sections symmetrical and unsymmetrical about centroidal axis. 3.2 **Bending stresses** 3.2.1 Theory of simple bending, equation of bending. 3.2.2 Assumptions in the theory of bending, moment of resistance, section modulus & neutral axis. Simple numerical. **Course Outcome: CO3 Teaching Hours: 8 Marks: 10(R-2, U-4, A-4)**
4	**Shear Force & Bending Moment** 4.1 Types of beams, types of supports, concept and definition of Shear force (S.F) and bending moment (B.M). 4.2 S.F and B.M diagrams for simply supported, overhang beams subjected to point load & UDL. Location of point of contraflexure and maximum bending moment calculations (if any).

	(No problem to be set for External moment or couple), 4.3 S.F and B.M diagrams for cantilever subjected to point load & UDL. Location of point of contraflexure and maximum bending moment calculations (if any). (No problem to be for External moment or couple) **Course Outcome: CO4 Teaching Hours: 10 Marks: 12 (R-2, U-6, A-4)**
5	**Direct and bending stresses** 5.1 Concept of direct and bending stresses, section modulus. 5.2 Eccentric loads, core or kernel of section, middle third rule, middle fourth rule. 5.3 Members of uniform sections subjected to eccentric loads with eccentricity and stress distribution at the base. 5.4 Structure subjected to horizontal, vertical loads e.g. tie bars, columns etc. **Course Outcome: CO5 Teaching Hours: 6 Marks: 8 (R-0, U-4, A-4)**
6	**Strain Energy & Torsion** **6.1 Strain Energy** 6.1.1 Definition and Concept of Strain energy, 6.1.2 Types of loading gradual, sudden & Impact loading. 6.1.3 Stresses developed due to gradual, sudden & impact load. 6.1.4 Strain energy stored due to gradual, sudden & impact loading. 6.1.5 Resilience, proof resilience and modulus resilience. **6.2 Torsion** 6.2.1 Stresses, strain & deformations in determinate shafts of solid & hollow, Homogeneous & composite circular cross section subjected to twisting moment. 6.2.2 Derivation of torsion equation. Simple Numericals **Course Outcome: CO6 Teaching Hours: 7 Marks: 10 (R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Mechanical Properties of Materials, Simple stresses & Strains**	2	4	4	10
2	**Principal planes & Principal stresses**	2	4	4	10
3	**Moment of Inertia & Bending stresses**	2	4	4	10
4	**Shear Force & Bending Moment**	2	6	4	12
5	**Direct and bending stresses**	-	4	4	08
6	**Energy & Torsion**	2	4	4	10
	Total	**10**	**26**	**24**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Tensile test on Mild steel/ Aluminium specimen, plotting of stress strain curve and indicating significant point as per I.S. requirement	04
2	1	CO1	Izod impact test on M.S., Copper, Aluminum and Brass	02
3	2	CO2	To find principal stresses and to locate principal plane using Mohr circle method and validate the same with numerical method. (Two different cases)	02
4	2 and 4	CO3 and CO4	Bending test on mild steel/timber.	04
5	3	CO3	Assignment on Moment of Inertia & Bending stresses.	02
6	4	CO4	To draw shear force and bending moment diagram for different kinds of loads	02
7	5	CO5	Assignment on Direct and bending stresses.	02
8	6	CO6	Assignment on Strain Energy & Torsion.	02
9	1	CO1	Shear test – Single and double shear for mild steel bar	02
10	1	CO4	Deflection test on timber / metal specimen	02
11	6	CO6	Torsion test on metal bar	02
12	1	CO1	Hardness test (Brinell Hardness) on various metals.	02
13	1	CO1	Compression testing on metal/timber.	02
			Total	**30**

Note: All experiments/assignments are compulsory

References/ Books:

Sr. No	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Strength of Materials	S. Timoshenko, D. Van Nostrand Company Inc. 3rd Ed, 1956	978-1124-1550-98
2	Strength of Materials	R.K. Bansal, Laxmi Publication Pvt Ltd. Revised Ed, 2010	978-8131-8081-46
3	Strength of Materials	R. K. Rajput, S. Chand & Company Ltd., 5th Ed, 2015	978-9385-4013-67
4	Strength of Materials	S. Ramamrutham, Dhanpat Rai and sons Publishing House, 16th Ed, 2011	978-9384-3782-64
5	Text Book of Strength of Materials	R.S. Khurmi, S. Chand & Company Ltd. 2015	978-9385-4019-54
6	Study of Materials	Ferdinand L. Singer, Harper & Row Publisher, New York, 4th Ed	978-0063-5059-95

E-References:

1) https://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/strength%20of%20materials/homepage.htm
2) https://onlinecourses.nptel.ac.in/noc17_ce22/preview
3) https://nptel.ac.in/Aeronautical/Strength%20of%20Materials/course_strength%20of%20materials.pdf

4) https://www.slideshare.net/khagendragautam/strength-of-material-3-som-mechanical-engineering-handwritten-classes-notes-study-materials-for-ies-ps-us-gate

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	1	2	1	3	2	1
CO2	2	3	2	1	2	2	3	2	1
CO3	3	2	3	2	2	2	3	3	1
CO4	3	3	3	2	2	2	3	3	1
CO5	3	3	3	2	2	2	3	3	1
CO6	1	3	3	2	2	2	3	3	1

Industry Consultation Committee:

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Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:**ME19205**				Course Title: **Basic Thermodynamics**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
2	**2**	**--**	**04**	**60**	**20**	**20**	**--**	**--**	**25**	**125**

Abbreviations: TH- Theory; PR-Practical; TU-Tutorial; TS1 and TS2- Term Tests; OR-Oral Exam; TW: Term Work (progressive assessment), * Indicates assessment by External Examiner else internal assessment
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale: Basic thermodynamics is one of the core engineering subjects for mechanical engineering students. A diploma holder is supposed to maintain steam generators, turbines, compressors, IC engines, refrigerators and other power plant equipment. Therefore, it is essential to impart him basic concepts of thermodynamics, steam generators, steam turbines, and heat exchangers. This course will enable students to establish foundation required to design, operate and maintain these devices.

Course Outcomes: Student should be able to

CO1	Describe the basic concepts of thermodynamics.
CO2	Apply gas laws for given processes.
CO3	Describe various thermodynamic reversible processes.
CO4	Apply first and second law for the thermodynamic systems.
CO5	Describe the working, construction and applications of steam boilers.
CO6	Describe different modes of heat transfer.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Fundamental Concepts** 1.1 Thermodynamic state and system, boundary, surrounding, universe. Thermodynamic systems-closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic. Industrial examples of different thermodynamic systems. 1.2 Properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes. 1.3 Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy. **Course Outcome: CO1 Teaching Hours: 06 Marks: 10(R-4, U-2, A-4)**
2	**Ideal Gases** 2.1 Definition of an ideal gas, explanation of ideal gas laws – Boyle's law, Charle's law, Gay-Lussac's Law, Avogadro's law. 2.2 Universal gas constant, Characteristic gas constants, Specific heat at constant pressure,

	specific heat at constant volume of gas, simple problems on gas equation. **Course Outcome:CO2 Teaching Hours: 03 Marks:08 (R-2, U-2, A-4)**
3	**Thermodynamic Processes on Gases** 3.1 Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, 3.2 Equations representing the processes Derivation of work done, change in internal energy, rate of heat transfer for the above processes. **Course Outcome: CO3 Teaching Hours: 03 Marks:08 (R-2, U-2, A-4)**
4	**Laws of Thermodynamics** 4.1 Laws of conservation of energy, first law of thermodynamics (Joule's experiment), Limitations of first law of thermodynamics, Application of first law of thermodynamics to non-flow systems -Constant volume, constant pressure, Adiabatic and polytropic processes. 4.2 Steady flow energy equation, Application of steady flow energy to equation, turbines, pump, boilers, nozzles. 4.3 Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Clasius statement, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility, entropy. **Course Outcome: CO4 Teaching Hours:07 Marks:12 (R-4, U-2, A-6)**
5	**Properties of Steam& Steam Generators** 5.1 Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of steam, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes 5.2 Quality of steam (dryness fraction).(Numerical) 5.3 Steam Generators : 5.4 Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction features of Cochran, La-mont and Loeffler, Lancashire boiler, Babcock & Wilcox Boiler. Boiler mountings and accessories, Introduction to modern boilers. **Course Outcome: CO5 Teaching Hours: 06 Marks:12 (R-2, U-4, A-6)**
6	**Introduction to Heat Transfer** 6.1 Modes of heat transfer conduction, convection and radiation. 6.2 Conduction- Fourier's law, thermal conductivity conduction through cylinder, thermal resistance, composite walls, list of conducting and insulating materials. 6.3 Convection- Newton's law of cooling, Natural and forced convection. 6.4 Radiation- thermal radiation, absorptivity, emissivity, black and grey bodies, Stefan – Boltzmann law. 6.5 Heat exchangers – classification, construction and working of shell and tube, shell and coil, pipe in pipe type and plate type heat exchanger. **Course Outcome: CO6 Teaching Hours: 05 Marks: 10 (R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Fundamental Concepts**	4	2	4	10
2	**Ideal Gases**	2	2	4	8
3	**Thermodynamic Processes on Gases**	2	2	4	8
4	**Laws of Thermodynamics**	4	2	6	12
5	**Properties of Steam & Steam Generators**	2	4	6	12
6	**Introduction to Heat Transfer**	2	4	4	10
Total		**16**	**16**	**28**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments / Assignment	Hours
1	1	CO1	Assignment on fundamental concepts of thermodynamics.	02
2	2	CO2	Assignment on ideal gases.	02
3	3	CO3	Assignment on thermodynamic processes on Gases.	02
4	4	CO4	Assignment on Laws of Thermodynamics.	02
5	5	CO5	Demonstration of working of different types of boilers. Such as Nestler boiler, Cochran, La-mont and Loeffler, Lancashire boiler, Babcock & Wilcox Boiler.	04
6	5	CO5	Study of boiler of mountings.	02
7	5	CO5	Study of boiler accessories.	02
8	5	CO5	Determination of dryness fraction of a given sample of steam by using separating calorimeter.	02
9	5	CO5	Visit to industry using boiler.	02
10	6	CO6	Demonstration of heat transfer through conduction, convection and Radiation	02
11	6	CO6	Calculate thermal conductivity of metallic rod.	04
12	6	CO6	Identify different equipment in power engineering lab having heat exchangers and classify heat exchangers. Write construction and working of any 03 of above heat exchangers.	04
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering Thermodynamics	PK Nag; Tata McGraw Hill,Delhi, 6th Ed, 2005	978-9352-6064-29
2	Basic Engineering Thermodynamics	Roy Chaudhary; Tata McGraw Hill,Delhi, 8th Ed, 1973	978-0070-9658-81
3	Engineering Thermodynamics	CP Arora; Tata McGraw Hill,Delhi, 2017	978-0074-6201-44
4	Thermal Engineering	R.S. Khurmi,& J.K.Gupta S. Chand Technical Publication, 2006	978-8121-9257-30
5	Thermal Engineering	P.L.Ballaney ,Khanna Publication, 24th Ed, 2009	978-8174-0903-17
6	A Course in Thermal Engineering	Domkundwar .S, Kothandaraman C. P. Domkundwar, Dhanpat Rai & sons. 2016	978-8177-0002-14
7	Thermal Engineering	M.M.Rathore, Tata McGraw Hill, 2010	978-0070-6811-32
8	Thermal Engineering	Rajput R.K, Firewall Media, New Delhi 2005	978-8170-0883-49

E-References:

1. https://swayam.gov.in/
2. www.youtube.com
3. https://learnengineering.org/
4. https://nptel.ac.in/

CO Vs PO and CO Vs PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	2	1	2	2	2	1
CO2	2	2	1	1	2	2	1	2	2
CO3	3	2	2	2	2	2	2	2	3
CO4	3	3	3	2	2	1	2	2	3
CO5	3	3	3	2	2	2	2	2	3
CO6	3	2	2	2	2	1	2	2	3

Industry Consultation Committee:

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I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: **ME19206**				Course Title: **Theory of Machines**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs. 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**-**	**-**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale: In industries, the Mechanical Engineers/Technicians are supposed to manage functioning of equipment with proper planning, operation and maintenance of equipment. Such a functional requirement needs knowledge and skills of various motion and force transforming mechanisms and devices, such as four bar mechanism, belt pulley, clutches, flywheel, etc. This course is included in the curriculum to provide such necessary knowledge and skills in the area of mechanical equipment and devices to help in understanding of kinematics & dynamics of different equipment being used in industry. Thus, it is a key course for Mechanical Engineers/Technicians to develop following skills: i. Draw inversions and determine velocity and acceleration of different mechanisms. ii. Construct different types of cam profile for a given data. iii. Calculate loss of power due to friction in various machine elements. iv. Solve problems on power transmission. v. Construct turning moment diagram. vi. Calculate balancing mass and its position.

Course Outcomes: Student should be able to

CO1	Identify kinematic parameters of machine.
CO2	Explain the kinematic/Geometric relationship of motion parameters
CO3	Explain working of flywheel/governor and balancing of machine elements
CO4	Draw profile of radial cam with knife edge / roller follower
CO5	Calculate power transmission in belt drives
CO6	Explain working of dynamometers and power transmission in cutches/brakes

Course Content Details:

Unit No	Topics / Sub-topics
1	**Fundamentals of Kinematics and Mechanisms** 1.1. Definition of Kinematics, Dynamics, statics, Kinetics, Kinematics link, Kinematics pair and its types, 1.2. Constrained motion and its types, Kinematic chain and its types, machine and structure. Mechanism, Degree of freedom. 1.3. Inversions of Kinematic Chain: Four bar chain, Single slider Crank and Double Slider Crank Chain **Course Outcome: CO1 Teaching Hours : 6 Marks: 8 (R- 4 U-4, A-0)**
2	**Kinematic Analysis of Plane Mechanism**: 2.1. Concept of relative velocity and relative acceleration of a point on a link, angular acceleration, inter-relation between linear and angular velocity and acceleration. Drawing of velocity and acceleration diagram of simple Mechanism. 2.2. Determination of velocity and acceleration of point on link by relative method (Excluding Coriolis's component of acceleration). 2.3. Analytical method and Klein's construction to determine velocity and acceleration of different links of single slider crank mechanism. **Course Outcome: CO2 Teaching Hours : 8 Marks: 12 (R-2, U-4,A-6)**
3	**Flywheel , Governor and balancing** 3.1. **Flywheel:** Flywheel –Concept, function and application of flywheel with the help of turning moment diagram for single cylinder 4-Stroke I.C Engine (no numerical) Coefficient of fluctuation of energy, coefficient of fluctuation of speed and its significance. 3.2. **Governors**: Types, concept, function and application and Terminology of Governors. Comparison between Flywheel and Governor. 3.3. **Balancing:** Introduction Static Balancing, Dynamic Balancing. Concept of Balancing, balancing of single revolving mass, Graphical and numerical method for balancing several masses in the same plane. **Course Outcome: CO3 Teaching Hours : 8 Marks: 10 (R-2 , U- 4,A-4)**
4	**Cam and Followers** 4.1. Concept, definition and application of Cams and followers. 4.2. Classification of Cams and followers Different follower motions and their displacement diagrams like uniform velocity, SHM, uniform acceleration and Retardation. 4.3. Drawing of profile of radial cam with knife edge and roller follower with and without offset with reciprocating motion. **Course Outcome: CO4 Teaching Hours : 7 Marks: 10 (R- 4 , U- 0 , A- 6)**
5	**Power Transmission** 5.1. Belt Drives- flat belt, V-belt & its applications, material for flat and V-belt. Selection of belts, angle of lap belt length Slip and creep. Determination of velocity ratio, of tight side and slack side tension, centrifugal tension and initial tension, condition for maximum power transmission (Simple numerical). 5.2. Chain Drives- Types of chains and sprockets, velocity ratio. Advantages & Disadvantages of chain drive over other drives, Selection of Chain & Sprocket wheels, methods of lubrication.

Unit No	Topics / Sub-topics
	5.3. Gear Drives – Spur gear terminology, types of gear trains and Law of gearing. **Course Outcome:CO5 Teaching Hours : 8 Marks:10 (R-4 , U-0 , A- 6)**
6	**Friction Bearing & Clutches, Brakes and Dynamometer** 6.1. Definition of friction, its necessity, Laws of friction, Friction between dry surfaces, coefficient of friction. Pivot and collar friction, uniform pressure and uniform wear assumptions, power absorbed in flat, and conical pivot bearings. Study of single plate, multiple plate, cone and centrifugal clutch. Simple numerical on power transmitted by them. 6.2. Definition Classification and comparison between brakes and dynamometers. Construction and working of Block brake, Band brake, Combined block and band brake, Internality expanding shoe brake and disc brake. (Numerical to find braking force and braking torque and power for block, band and block and band brake). 6.3. Construction and working of Rope brake dynamometer, Hydraulic dynamometer and Belt type transmission dynamometer. **Course Outcome: CO6 Teaching Hours : 8 Marks: 10 (R-2 , U- 4 , A-4)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Fundamentals of Kinematics and Mechanisms**	4	4	0	08
2	**Kinematic Analysis of Plane Mechanism**	2	4	6	12
3	**Flywheel , Governor and balancing**	2	4	4	10
4	**Cam and Followers**	4	0	6	10
5	**Power Transmission**	4	0	6	10
6	**Friction Bearing & Clutches, Brakes and Dynamometer**	2	4	4	10
	Total	**18**	**16**	**26**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Describe working of mechanisms and their inversions.	02
2	1	CO1	Mini project : Prepare any two models of mechanisms or inversions.	04
3	2	CO2	Determine and draw velocity and acceleration diagram using relative velocity method for any four problems.	04
4	2	CO2	Draw Klein's Construction for Single slider mechanism.	04

Sr. No.	Unit No	COs	Title of the Experiments	Hours
5	3	CO3	Determine analytically and graphically balancing of several masses rotating in a single plane (Minimum two problems).	04
6	4	CO4	Draw two cam profiles on drawing sheets for the problems having without offset.	04
7	4	CO4	Draw two cam profiles on drawing sheets for the problems having with offset.	04
8	5 & 6	CO5 CO6	Mini Project: 1. Compile information from internet related to various mechanisms/elements like piston, crank, connecting rod, cam, clutch, brake, flywheel, governor, or animation of mechanism etc. along with functions of each and prepare presentation. 2. Assignment on nomenclature of Helical Gears and worm and worm wheel	04
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Theory of Machines	R. S. Khurmi and J. K. Gupta, S. Chand and Co. Ltd., 14th edition, 1976	978-8121-9252-42
2	Theory of Machines	P. L.Ballaney, Khanna Publication, 25th edition, 1965	978-8174-0912-22
3	Theory of Machines	S.S. Rattan, McGraw Hill India, 5th edition, July 10, 2019	978-9353-1662-81
4	Theory of Machines	Sadhu Singh, Pearson Education India, 2005	978-8177-5812-70
5	Theory of Machines	Thomson Bevan, Persons Education Ltd, 3rd edition, 2010	978-8131-7296-56

E-References:

1. https://nptel.ac.in/
2. https://www.slideshare.net/ahirehemant/theory-of-machine
3. https://www.youtube.com/watch?v=jzNik6PEKG8
4. https://www.youtube.com/watch?v=MJeRFzs4oRU

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	2	2	2	2	2
CO2	2	2	3	3	2	2	3	3	2
CO3	2	2	2	3	2	2	3	3	2
CO4	2	2	2	3	2	2	3	3	2
CO5	2	2	2	2	2	2	3	2	2
CO6	2	2	2	2	2	2	3	2	2

Industry Consultation Committee:

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Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19301				Course Title: **Machine Drawing & Computer Aided Drafting**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
-	4	-	4	-	-	-	25*	--	25	50

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid-term and second skill test at the end of the term.

Rationale:

A Mechanical Engineer, irrespective of their field of operation in an industry, is expected to possess a thorough understanding of drawing, which includes clear visualization of objects and the proficiency in reading and interpreting a wide variety of production drawings. Besides, they are also expected to possess certain degree of drafting skills depending upon job function, to perform day to day activity i.e. communicating and discussing ideas with supervisors and passing on instructions to subordinates unambiguously.

In the engineering world, CAD is revolutionized modern day engineering and widely used to design and develop products to be used by consumers. CAD allows for the easier development of products and product management integration. CAD drawings offer the flexibility to draft and design in a digital sphere, which were previously done by hand. The digital format makes data handling easier, safer, and quicker. Prior hand drawn blueprints can be scanned and then can be expanded upon digitally. Many CAD programs are now using three-dimensional drawings to maximize productivity and provide quicker, better product results, allowing for the development of the tiniest details. CAD's excellent ability for comprehensive documentation and communication allows for an easier product management environment.

Course Outcomes: Student should be able to

CO1	Apply appropriate limits, fits, tolerances & surface finish on drawing.
CO2	Use standard conventions of mechanical elements as per SP-46(1988).
CO3	Interpret & Draw production drawings of components/parts for a given assembly.
CO4	Visualize details of components and draw assembly of components.
CO5	Draw 2-D drawings, assembly drawings using layers, and Print/Publish the drawings.
CO6	Create Isometric, 3-D drawings of mechanical components & Print /Publish the drawings

Course Content Details:

Unit No	Topics / Sub-topics
1	**Limits, Fits and Tolerances** 1.1 Introduction to ISO system of tolerancing, dimensional tolerances, elements of interchangeable system, hole & shaft basis system, limits, fits & allowances. Selection of fit. (Simple Numerical) 1.2 Geometrical tolerances, tolerances of form and position and its geometric representation. 1.3 Characteristics of surface roughness - Indication of machining symbol showing direction of lay, roughness grades, machining allowances, manufacturing methods. **Course Outcome: CO1**
2	**Production Drawing Basics** 2.1 Conventional Representations using SP – 46 (1988) 2.1.1 Materials C.I., M.S, Brass, Bronze, Aluminum, wood, Glass, Concrete and Rubber 2.1.2 Long and short break in pipe, rod and shaft. 2.1.3 Ball and Roller bearing, pipe joints, cocks, valves, internal / external threads. 2.1.4 Various sections- Half, removed, revolved, offset, partial and aligned sections. 2.1.5 Knurling, serrated shafts, splined shafts, and chain wheels. 2.1.6 Springs with square and flat ends, Gears, sprocket wheel 2.1.7 Countersunk & counter bore. 2.1.8 Tapers 2.2 **Welded Joints:** Representation of the following weld & preparing working drawing showing the size of weld, weld length, flush finish etc. Fillet 2.2.1 Square butt 2.2.2 Single and double U 2.2.3 Single and double V 2.2.4 Single and double J 2.2.5 Bevel butt 2.2.6 Edge / seam / bead 2.2.7 Spot weld 2.2.8 All round weld 2.2.9 Flush finish weld **Course Outcome: CO2**
3	**Introduction to Computer Aided Drafting**: 3.1 Various Software's for Computer Aided Drafting. 3.2 CAD initial settings commands. 3.3 Object Selection methods **Course Outcome: CO3**
4	**Basic Commands in CAD** 4.1 Zoom and formatting Commands: 4.1.1 Zoom Commands – all, previous, out, in, extent, realtime, dynamic, window, pan. 4.1.2 Formatting commands - Layers, block, linetype, lineweight, color. 4.2 Draw and Enquiry commands: 4.2.1 Draw Command - Line, arc, circle, rectangle, polygon, ellipse, point, spline, block, hatch etc. 4.2.2 Enquiry commands - distance, area, volume, and list command. 4.3 Edit and Modify commands: 4.3.1 Modify Command - Erase, break, trim, copy, move, mirror, offset, fillet, chamfer, array, extend, rotate, scale, lengthen, stretch, measure, divide, explode, align, join, spline edit Commands.

	4.4 Dimensioning, Text and Plot Commands: 4.4.1 Dimensioning commands - Dimension styles, Dimensional Tolerances and Geometrical Tolerances, ddedit. 4.4.2 Text commands – Text style, dtext, mtext command. 4.4.3 Plotting & Publishing a drawing – creating standard template, title block, creating table, Bill plot Commands. 4.5 Drawing the given Sketches & Production Drawing of machine components. **Course Outcome: CO4**
5	**Assembly drawing** 5.1 Assembly to Details: Introduction – basic principles of dismantling process. Preparation of detailed working drawing from given assembly, indicating proper type of fit & tolerance relevant to that fit and the grade of surface finish required. The drawing to be self-explanatory for manufacturing of the components. The objects may be selected from the following & not containing more than 8 parts: 5.1.1 Lathe Tail Stock 5.1.2 Jigs & Fixtures 5.1.3 Piston & connecting rod assembly 5.1.4 Gland and Stuffing box Assembly 5.1.5 Valves: Steam Stop Valve & Non – Return Valve 5.1.6 Fast & loose pulley 5.2 Details to Assembly: Preparation of the assembly drawings from the given detailed drawings of the parts of machine unit. Objects may be selected from the following & not containing more than 8 parts. 5.2.1 Couplings – Universal couplings & Oldham's Coupling 5.2.2 Bearing – Foot Step Bearing & Pedestal Bearing 5.2.3 Lathe tool Post, Tail stock 5.2.4 Machine vice & Pipe Vice 5.2.5 Screw Jack 5.2.6 Jigs and Fixtures 5.2.7 Valves: Steam stop valves & Non Return Valves, **Course Outcome: CO5**
6	**Isometric and 3D Drawings:** 6.1 Drawing of Isometric Views from orthographic views of objects using CAD. 6.2 Drawing of 3D (pictorial) objects from the Two/Three views of the objects using CAD. **Course Outcome: CO6**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hrs
1	3	CO1	Assignment on Limit, Fit, Tolerances and Machining Symbols in sketch book	02
2	4	CO2	Assignment on Conventional Representation as per SP – 46 (1988) in sketch book	02
3	4	CO2	Assignment on welded joints in sketch book	02
4	4	CO3	Assignment on Redraw Figures & Isometric View in sketch book (Minimum 4 problems each)	02
5	1	CO3	Assignment on Assembly to Details in sketch book (Minimum 2 problems)	06
6	2	CO4	Assignment on Details to Assembly in sketch book (Minimum 2 problems)	06

Sr. No.	Unit No	COs	Title of the Experiments	Hrs
7	2	CO3	Generation of production drawings of the machine parts and assembly with appropriate tolerances using layer, blocks & dimensions in CAD.	08
8	3	CO5	Draw Assembly of machine components with layer, blocks & dimensions in CAD. (Minimum 2 problems).	08
9	4	CO5	Draw Detail of assembly of machine components with layer, blocks & dimensions in CAD. (Minimum 2 problems).	08
10	5	CO6	Draw Isometric drawing in CAD. (Minimum 08 objects)	08
11	4	CO6	Draw 3D drawings in CAD. (Minimum 06 objects),	08
			Total	**60**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Machine Drawing	N. D. Bhatt, Charotar Publishing House, 50th edition, 2016	978-9385-0392-32
2	Production Drawing	L. K. Narayanan, P. Kannaich, K. Venkat Reddy, New Age International Publication, 3rd edition, 2006	978-8122-4251-85
3	Machine Drawing	N Sidheswar, P Kannaiah &V V S Sastry, Tata McGraw Hill Education Pvt. Ltd., 2010	978-0074-6033-76
4	Machine Drawing	N. D.Junnarkar, Pearson, 2006.	978-8131-7067-87
5	IS Code SP 46 (2003)	Code of practice for general engineering drawing, Engineering Drawing Practice for School and colleges, Bureau of Indian Standards, 9 Bahadur Shah Zafar Marg, New Delhi 110002	81-7061-019-2
6	AutoCAD: A Problem-Solving Approach	Sham Tickoo, Delmar Cengage Learning (31 January 1998)	978-0766-8012-95
7	Machine Drawing with AutoCAD	Gautam Purohit & Gautam Ghosh, Pearson Publication	978-1299-4461-82
8	Mastering AutoCAD and AutoCAD LT 2018	George Omura, BPB Publication	978-1119-3867-97

E-References:

1. http://www.we-r-here.com/cad/tutorials/index.htm
2. http://www.cadtutor.net/tutorials/autocad/
3. http://www.caddprimer.com/AutoCAD_training_tutorial/AutoCAD_training_lessons.htm
4. http://www.autocadmark.com/
5. http://www.autocadtutorials.net/
6. www.youtube.com

7. EKHO Institute presents Professional AutoCAD Training Videos
8. Learning AutoCAD 2012 Tutorial DVD – Publisher – Infinite Skills Inc.
   Email : directsales@infiniteskills.com

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	3	3	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	2
CO3	3	2	3	3	2	2	3	3	2
CO4	3	2	2	2	2	2	3	3	2
CO5	3	2	3	3	2	2	3	3	2
CO6	3	2	3	3	2	2	3	3	2

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Coordinator,
Curriculum Development,
Department of Mechanical Engineering _

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19207				Course Title: Fluid Mechanics and Machinery						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
2	**2**	**--**	**4**	**60**	**20**	**20**	**--**	--	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Hydraulic machines have important role in water supply, irrigation, power generation and in most of the engineering segments. Knowledge of fluid properties, fluid flow and fluid machinery is essential in all fields of engineering. This course is intended to develop the skills to estimate loss in pipes, efficiency of hydraulic machines like turbines, pump etc., head on a pump and select a pump for a particular application. Diagnose and rectify the faults in pumps and turbines, replace the pressure gauges and other accessories on hydraulic machines and apply their knowledge in hydraulics to select appropriate devices like pressure gauge, valves, flow devices, pipes etc. for different field applications.

Course Outcomes: Student should be able to

CO1	Use manometers and Bourdon gauge to measure pressure.
CO2	Use flow meters to measure the rate of flow.
CO3	Analyze flow through pipes.
CO4	Analyze impact of jet on various types of vanes for optimum efficiency.
CO5	Analyze performance of hydraulic turbine
CO6	Analyze performance of hydraulic pump

Course Content Details:

Unit No	Topics / Sub-topics
1	**Properties of Fluid and Fluid Pressure** **1.1.** Properties of Fluid: Density, Specific Gravity, Specific volume, Dynamic Viscosity, Kinematic viscosity, Surface tension, Capillarity, Vapor pressure, Compressibility. **1.2.** Fluid Pressure and Pressure Measurement: Fluid pressure, Pressure head, Pressure intensity, Concept of absolute vacuum, Gauge pressure, Atmospheric pressure, Absolute pressure, Simple and differential manometers, Bourdon's tube pressure gauge. Total pressure, Center of pressure (Horizontal, Vertical, Inclined surfaces). **Course Outcome: CO1 Teaching Hours: 05 Marks: 08 (R- 02, U-04, A-02)**

2	**Fluid Flow.** **2.1.** Types of fluid flow: Laminar, Turbulent, Steady, Unsteady, Uniform, Non uniform, Rotational, Irrotational, One, Two, Three dimensional. **2.2.** Continuity equation. Bernoulli's Theorem **2.3.** Venturimeter – Construction, Principle of working, Coefficient of discharge, Derivation of discharge through Venturimeter. **2.4.** Orifice meter - Construction, Principle of working, Hydraulic coefficients for orifice, Derivation for discharge through orifice meter **2.5.** Pitot tube- Construction, Principle of working. **Course Outcome: CO2 Teaching Hours: 05 Marks: 10 (R-02, U- 04, A-04)**
3	**Flows Through Pipes.** **3.1.** Laws of fluid friction. Darcy's equation & Chezy's equation for loss of head due to friction. **3.2.** Minor losses in pipe fittings and valves **3.3.** Hydraulic gradient line and Total energy line. **3.4.** Hydraulic power transmission through pipes **3.5.** Water hammer phenomenon in pipes, causes and remedial action **Course Outcome: CO3 Teaching Hours: 04 Marks: 10(R-02, U- 04, A-04)**
4	**Impact of Jets** **4.1.** Impact of jet on fixed Vertical, moving Vertical flat plates. **4.2.** Impact of jet on curved Vanes. **Course Outcome: CO4 Teaching Hours: 03 Marks: 06 (R-00, U- 02, A-04)**
5	**Hydraulic Turbines** **5.1.** Layout & features of hydroelectric power plant. **5.2.** Classification of hydraulic turbines. **5.3.** Construction & working principle of Pelton wheel Turbine, Francis Turbine, Kaplan Turbine. **5.4.** Draft tubes- types and construction, Concept of cavitations in turbine **5.5.** Calculation of work done & power efficiency of turbine. **Course Outcome: CO5 Teaching Hours: 07 Marks: 13(R-04, U- 06, A-03)**
6	**Hydraulic Pumps** **6.1.** Centrifugal pumps: Construction, Principle of working, Methods of priming & Cavitation. Types of casing & impellers. Manometric head, Work done, manometric efficiency, mechanical efficiency, Overall efficiency. Velocity diagrams, NPSH. Priming and its importance. **6.2.** Reciprocating pumps: Construction, working principles & applications of single & double acting reciprocating pumps, Concept of slip, negative slip. Cavitation and separation. Use of air vessel. Criteria for pump selection **Course Outcome: CO6 Teaching Hours: 06 Marks: 13(R-04, U-06, A- 03)**

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Fluid pressure & its measurement	02	04	02	08
2	Fluid flow	02	04	04	10
3	Flows through pipes	02	04	04	10
4	Impact of jets	-	02	04	06
5	Hydraulic turbines	04	06	03	13
6	Hydraulic pump	04	06	03	13
	Total	**14**	**26**	**20**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Use Bourdons pressure gauge and U tube manometer to measure water pressure and discharge of water using measuring tank and stop watch.	02
2	2	CO2	Verification of Bernoulli's theorem	04
3	2	CO2	Use Venturimeter to measure discharge through a pipe.	02
4	2	CO2	Determination of coefficient of discharge for flow through orifice.	02
5	3	CO3	Determine Darcy's friction factor 'f' in pipes of different diameters.	02
6	3	CO3	Determine frictional losses in sudden expansion, sudden contraction, bend and elbow in pipes	04
7	4	CO4	Assignment on impact of jet	02
8	5	CO5	Determine overall efficiency of Pelton Wheel	04
9	5	CO5	Trial on Francis turbine to determine overall efficiency.	04
10	6	CO6	Determine overall efficiency of Centrifugal Pump	02
11	6	CO6	Determine overall efficiency of Reciprocating Pump.	02
		Total		**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Hydraulics and Fluid Mechanics including Hydraulic Machines	Modi P. N. Seth S. M. Standard Book House New Delhi, 22nd Ed., 2013	978-8189-4012-69
2	Fluid Mechanics and Hydraulic Machine	Bansal R. K. Laxmi Publication Pvt. Ltd. New Delhi, 22nd Ed., 2018	978-8131-8081-53
3	A textbook of Fluid Mechanics and Hydraulic Machines	Rajput R. K. S Chand and Company Pvt. Ltd. New Delhi, 6th Ed., 2016	978-9385-4013-74
4	Fluid Mechanics and Hydraulic Machines problems and solution	Subramanya K. Tata McGraw Hill Co Ltd New Delhi, 4th Ed., 2011	978-0070-6998-09
5	Introduction to Fluid Mechanics and Fluid Machines	Som S. K. Biswas G Tata McGraw Hill Co Ltd New Delhi, 3rd Ed., 2005	978-0071-3291-94
6	A textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines	Khurmi R. S. S Chand and Company Pvt. Ltd. New Delhi, 9th Ed., 2015	978-8121-9016-28
7	Hydraulics, Fluid Mechanics and Hydraulic Machines	Ramamrutham S. Dhanpat Rai and Sons New Delhi, 9th Ed., 2011	978-9384-3782-71
8	Hydraulic Machines	Jagdish Lal Metropolitan 3rd Ed., 2008	978-8120-0042-21

E-References:

1. www.nptel.ac.in/courses
2. www.learnerstv.com
3. www.ni.com/multisim

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	3	2	2	2	2	3	3	2
CO2	2	3	3	3	2	2	3	2	2
CO3	3	2	3	2	2	2	3	2	2
CO4	2	3	2	2	2	2	2	3	2
CO5	3	3	2	3	2	2	3	3	2
CO6	2	3	3	3	2	2	2	3	2

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6	Miss. A. R. Hagawane	Lecturer in Mechanical Engineering	Government Polytechnic Mumbai

Coordinator, Head of Department
Curriculum Development, Department of Mechanical Engineering
Department of Mechanical Engineering

I/C, Curriculum Development Cell Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

P19 Curriculum

Fourth Semester

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -IV**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19309	MATERIALS TECHNOLOGY	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19402 ME19403 ME19404	**Optional Course-I** ***(Select any One)*** AUTOMOBILE ENGINEERING MATHEMATICS FOR MECHANICAL ENGINEERS NON CONVENTIONAL ENERGY RESOURCES	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19304	POWER ENGINEERING AND REFRIGERATION & AIR CONDITIONING	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19306	ADVANCED MANUFACTURING PROCESSES	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19307	PRODUCTION AND INDUSTRIAL ENGINEERING	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19312	BASICS OF MECHATRONICS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19101	ENGLISH	--	5#	--	5	5	--	--	--	--	--	--	**--**
	Total	**18**	**17**	**--**	**35**	**35**	**360**	**120**	**120**	**50**	**--**	**150**	**800**
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
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Head of Department
Dept. of Mechanical Engineering

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19309				Course Title: Materials Technology						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**25***	-	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Engineering industry consumes variety of engineering materials, metals as well as non-metals. Mechanical Engineering Technicians require to know the understanding of various materials with respect to their structure, properties and behavior. While working in different domains of Mechanical Engineering, technicians shall possess the competence to select appropriate materials for required application from the array of conventional ferrous and non- ferrous materials as well the advanced materials, productively.

In this context, the mechanical engineering diploma student must be well versed with steels, cast irons, nonferrous materials, composites and other advanced materials. Also the student is required to have hands- on learning experience on some destructive and non-destructive testing methods.
Hence it is apt to study this course with the objective to develop the competency of selection of appropriate material for required applications and material testing
.

Course Outcomes: Student should be able to

CO1	Apply basics of material crystal structures and mechanical properties of materials for required applications in material selection and perform optical metallography.
CO2	Interpret Iron and Iron Carbide Equilibrium Diagram and correlate microstructure of steels and cast irons with it
CO3	Describe characteristics of composite materials, and other advanced materials and select them for appropriate applications
CO4	Interpret characteristics, compositions and microstructures of non-ferrous materials and Identify ceramics for their proper selection for applications
CO5	Compare, select and perform various heat treatments on steels and CI
CO6	Describe and perform destructive, non-destructive tests on materials

Course Content Details:

Unit No	Topics / Sub-topics
1	**Materials Structures, Mechanical Properties and Metallography** 1.1 Classification of engineering materials, Mechanical properties of materials and their importance in material selection, crystal structures, unit cells, crystal parameters Average number of atoms, atomic packing factors for SC, BCC, FCC and HCP crystal cells, Theoretical Density Calculation, defects in crystal structures & their significance 1.2 *Metallography: Procedure of metallographic sample preparation for optical microscopy, etchants and etching action for two phase alloys, Principle of optical metallurgical microscope, its parts, magnification, concept of grain, grain boundary. [*This subtopic shall be taught in Lab] **Course Outcome: CO1 Teaching Hours:05 Marks: 08 (R-2, U-3, A-3)**
2	**Ferrous Materials** 2.1 Basic terminology: Definitions: Equilibrium diagram, phases, variables, components of equilibrium diagram, solid solution, types of solid solutions, alloys, Lever rule, Iron- Iron Carbide Equilibrium Diagram with details of phases, critical temperatures, Invariable metallurgical reactions 2.2 Plain Carbon Steels: Classification of steels based on carbon contents, their Cooling, microstructures, Applications of plain carbon steels 2.3 Specifications of steels: IS, AISI, EN systems 2.4 Cast Irons: Comparison of steels and cast irons, Classification of Cast Irons and form of carbon into them, factors influencing microstructures of cast irons, white cast irons, malleable cast iron, grey cast iron, nodular cast iron, Compacted Graphite Cast Iron, ADI, properties and applications of these cast irons **Course Outcome: CO2 Teaching Hours: 09 Marks: 12 (R-2, U-4, A-6)**
3	**Alloy Steels & Advanced Materials** 3.1 Need of alloy steels, Limitations of Plain Carbon Steels, effects of alloying elements 3.2 Maraging steel, HSLA steel, creep resistant steel, High temperature alloys, Low expansion steels 3.3 HSS- types & composition, Stainless steels: Types, composition and applications 3.4 Advanced Materials: Composite Materials- Definition, Need & advantages, Classification, PMC, MMC, CMC, nano composites, constituents, rue of mixture and applications, Processing of composites, Concept and behavior and applications of Shape Memory Alloys & Self-healing materials **Course Outcome: CO3 Teaching Hours:08 Marks:12 (R-2, U-4, A-6)**
4	**Nonferrous Materials & Ceramics** 4.1 Need of nonferrous materials, Properties, compositions and applications of Copper and its alloys: Cartridge brass, Muntz metal, season cracking of brasses, Aluminium bronze, Tin bronze, silicon bronze, Phospher bronze 4.2 Aluminium & its alloys: Properties, compositions and applications, LM5, LM6, LM14 4.3 Lead and Tin based sliding bearing materials (Babbits) 4.4 Ceramic Materials: Types and Applications of ceramics- Glass, Glass ceramics, Refractories, Abrasives, Advanced ceramics **Course Outcome: CO4 Teaching Hours:06 Marks:08 (R-2, U-3, A-3)**
5	**Heat Treatments** 5.1 Objectives of heat treatments, cooling media, cooling stages, Martensitic transformation, retained austenite, its effects,

	5.2 Heat Treatment Processes: Annealing: Conventional annealing, isothermal annealing, Spherodise annealing, Normalizing, Hardening: Conventional hardening, Martensitic Transformation, Tempering: Objectives, types, Process of tempering, Surface Hardening: Carburising, nitriding, Induction hardening, flame hardening, Heat Treatments for Cast Irons, Hardenability, Pollution & environmental issues related with heat treatments **Course Outcome:CO5 Teaching Hours:09 Marks:12 (R-2, U-5, A-5)**
6	**Testing of Materials** 6.1 Destructive Testing: Objectives & Procedures of Hardness Measurement: Brinell & Rockwell Method, Objectives & Procedures of Fatigue testing, Objectives & Procedures of wear testing, creep testing 6.2 Non-Destructive Testing: Objectives, Procedure, advantages and limitations of Dye Penetration Test, Magnetic Particle Test, Ultrasonic Crack Detection Test, Radiography Tests, Eddy current Test **Course Outcome: CO6 Teaching Hours:08 Marks:08 (R-2, U-3, A-3)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Materials Structures, Mechanical Properties and Metallography**	02	03	03	08
2	**Ferrous Materials**	02	04	06	12
3	**Alloy Steels & Advanced Materials**	02	04	06	12
4	**Nonferrous Materials & Ceramics**	02	03	03	08
5	**Heat Treatments**	02	05	05	12
6	**Testing of Materials**	02	03	03	08
	Total	**12**	**22**	**26**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	**1**	**CO1**	Use of optical metallurgical microscope	**2**
2	1	CO1	Preparation of Metallographic Sample	4
3	2	CO2	Interpretation of microstructures of various steels	2
4	2	CO2	Interpretation of microstructures of various Cast Irons	2
5	3	CO3	Interpretation of SMA behavior	2
6	4	CO4	Interpretation of microstructures of various nonferrous materials	2
7	5	CO5	Performance of heat treatment on steel sample	4

Sr. No.	Unit No	COs	Title of the Experiments	Hours
8	6	CO6	Hardness Measurement by Brinell Hardness Method and Rockwell Hardness Method	4
9	6	CO6	Performance of ultrasonic flaw detection Test	2
10	1-6	CO1-6	Mini Project (Teacher shall allot the task/topic to a group of five students. Group will submit a report after working on given task/ topic. Students to work throughout the semester on mini project)	4
11	5	CO5	Evaluation of hardenability of steel by Jominy End Quench Test	2
12	6	CO6	Performance of Dye Penetration Test	2
13	6	CO6	Performance of Magnetic Particles Test	2
14	6	CO6	Performance of creep Test	2
		Total		**30**

Note: Experiments No. 1 to 10 are compulsory, Minimum 11 experiments shall be performed. Remaining experiments are to be performed as per availability of time.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Material Science and Metallurgy for Engineers	Dr. V. D. Kodgire, S.V. Kodgire, Everest Publishing House, 44th Ed; 2018	978-8176-3140-08
2	Materials Science and Engineering, Introduction	William D Callister Jr, David G Rethwisch, Wiley, 9th Ed, 2014	978-1118-3245-78
3	Physical Metallurgy for Engineers	Donald S. Clark, Wilbur R. Varney, CBS Publishers & Distributors, 3rd Edition, 2004	978-8123-9117-86
4	A Text Book of Materials Technology	S. B. Barve, Vipul Prakashan, 1st Ed, 2014	978-9382-7916-14
5	Self-Healing Materials: Principles and Technology	George Wypych, Chemtec Publishing, 1st Ed, 2017	978-1927-8852-39

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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	3	2	3	2	2
CO3	3	2	3	3	2	2	2	3	2
CO4	3	2	2	3	-	2	2	3	2
CO5	3	2	3	3	3	3	2	3	3
CO6	3	2	3	3	3	2	2	3	3

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Coordinator,
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Head of Department
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I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:**ME19402**				Course Title: **Automobile Engineering**						
Compulsory / Optional: **Optional**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**--**	**25**	**125**

Abbreviations: TH- Theory; PR-Practical; TU-Tutorial; TS1 and TS2- Term Tests; OR-Oral Exam; TW: Term Work (progressive assessment), * Indicates assessment by External Examiner else internal assessment

Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Automobile sector has been helping the world for the overall development and it has been creating wage and self-employment opportunities both in public and private sectors. Mechanical engineering technologists should have an overall understanding of various aspects of automobile systems.

This course provides knowledge about the different vehicle layout, transmission and controls, electrical and electronics systems, vehicle safety and security, motor vehicle acts along with automobile maintenance. This will help learner to develop employability skills in automobile industry.

Course Outcomes: Student should be able to

CO1	Prepare vehicle layouts with chassis specification.
CO2	Interpret power flow diagrams of transmission systems.
CO3	Select suitable braking and steering systems for different applications.
CO4	Select tyres and suspension system for different applications
CO5	Describe simple electrical – electronics circuits for automobile systems.
CO6	Describe automobile air conditioning system.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to automobiles** 1.1 Automobile: definition, classification of automobiles, major components of automobiles with their function and location. Basic engine components; Cylinder block; Cylinder head; Gaskets; cylinder liners, types of cylinder liners; Piston and piston pin; piston rings, types of piston rings; Connecting rod; Crank shaft; Cam shaft; Crankcase; Engine valves; Flywheel and Governor. 1.2 Cooling and lubrication system: The necessity of cooling system; Types of cooling system-air cooling and water cooling; Types of water cooling system – Thermosyphon system and pump circulation system; Advantages and disadvantages of air cooling and water cooling systems; The components of water cooling system –fan, radiator, pump and thermostat; The necessity of lubrication system; S.A.E rating of lubrication system; Types of lubrication system; Petrol lubrication and high pressure lubrication system

Unit No	Topics / Sub-topics
	1.3 Fuel feed system: Conventional fuels and alternative fuels: Cetane and octane numbers; Types of carburetors; Working of simple carburetor; Multi point and single point fuel injection systems; Different fuel transfer pumps; Working of S.U electrical and A.C mechanical pump; Fuel filters; Fuel injection pump; Fuel injectors. 1.4 Functions of chassis, frame and body: Basic body nomenclature **1.5** Alternative fuels: LPG and CNG: need, fuel characteristics, advantages, limitations. Layout of electric vehicles, need, working, advantages, limitations. Hydrogen as fuel **1.6** Recent trends and future developments in Automobiles: Hybrid vehicles, driverless cars. Automatic transmission. **Course Outcome: CO1 Teaching Hours:12 Marks:16 (R-4, U-8, A-4)**
2	**Transmission system** 2.1 Need and Requirements of transmission system. Its components and their functions 2.2 Clutch: Function and purpose of clutch, types and construction of clutches such as single plate and multiplate type, Faults & remedies in clutch 2.3 Gearbox: Constant mesh & synchromesh gear box with their construction and operation 2.4 Propeller shaft-construction and functions **2.5** Differential-need, construction and working, differential action and operation **2.6** Axle-Hotchkiss and torque tube drives, rear axle-full floating axle, semi-floating and three quarter floating axle. Front axle. **Course Outcome: CO2 Teaching Hours:08 Marks: 10(R-2, U-4, A-4)**
3	**Control Systems** 3.1 Steering System: Purpose, functions & types of steering system. Construction and working of recirculating ball type and rack and pinion type. Wheel Geometry-caster, camber, king pin inclination, Toe In and Toe Out. Power steering (introductory) 3.2 Braking System: Need of braking system, types of automotive braking systems, mechanical, hydraulic and air operated. Hydraulic braking systems: Layout & components of hydraulic braking Systems. Construction and working of master cylinder and wheel cylinder, Tandem cylinder. Drum braking system, Disc Braking Systems, Air braking system: layout and working **Course Outcome: CO3 Teaching Hours:08 Marks:10(R-4, U-4, A-2)**
4	**Suspension System, wheel and Tyres** 4.1 Suspension System: Necessity and classification of suspension system, front and rear suspension system, construction and working of Wishbone type, Mac Pherson type, Trailing link type, coiled springs, leaf spring and shock absorbers, air suspension system

Unit No	Topics / Sub-topics
	4.2 Wheels and Tyres: Types of wheels-spoked, disc, light alloy cast. Types of rims. Tyres-Desirable properties, types-redial ply, cross ply, tubeless. Factors affecting tyre life. **Course Outcome:CO4 Teaching Hours:06 Marks:08 (R-2, U-4, A-2)**
5	**Electrical Systems** 5.1 Ignition system: Introduction to ignition system; Battery Ignition systems and magneto Ignition system; Electronic Ignition system; Construction and working of lead acid battery; Elements of starting system; Types of lights used in the automobile 5.2 Battery: Automotive battery construction and operation, battery capacity, Battery ratings, Battery tests. Charging System: Need of charging system, Construction and operation of charging system, Dynamo, Alternator principle, construction and working 5.3 Starting System: Need of starting system layout, Bendix and solenoid drive **Course Outcome: CO5 Teaching Hours: 06 Marks: 10(R-2, U-4, A-4)**
6	**Automobile Air conditioning System** 6.1 Locate various components of air conditioning systems in a vehicle **6.2** Introduction, layout of car air conditioning system, components of a system, working of a system, parameter control (Humidity, temperature, purity of air) required **6.3** Important precautions while using AC system. **Course Outcome:CO6 Teaching Hours: 05 Marks: 06(R-2, U-2, A-2)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Automobiles	04	08	04	16
2	Transmission system	02	04	04	10
3	Control Systems	04	04	02	10
4	Suspension System, wheel and tyres	02	04	02	08
5	Electrical Systems	02	04	04	10
6	Automobile Air conditioning System	02	02	02	06
	Total	**16**	**26**	**18**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	To draw vehicle layout. (2 wheeler and 4 wheeler)	4
2	1	CO1	Demonstration of auto transmission in automobiles.	2
3	2	CO2	Dismantle and assemble single plate clutch	2
4	2	CO2	Dismantle and assemble multi plate clutch	2
5	2	CO2	Dismantle and assemble the propeller shaft assembly.	2
6	2	CO2	Dismantle and assemble synchromesh gear box or constant mesh gear box.	2
7	2	CO2	Dismantle and assemble Differential gear box of automobile.	2
8	3	CO3	Dismantle and assemble the power steering system.	2
9	3	CO3	Dismantle brake system (drum /disk) and observe various components of it. Write function of important components.	4
10	4	CO4	Dismantle and assemble leaf spring, torsion bar, dependent & independent suspension.	2
11	4	CO4	Dismantle and assemble the wheel and tyre assembly.	2
12	5	CO5	Testing of battery like Ah rating, type of battery, no. of cells, vents, charge status by using hydrometer and voltmeter.	2
13	6	CO6	Demonstration of car air-conditioning system.	2
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year of publication	ISBN
1	A Text book of Automobile Engineering	Rajput R.K, Laxmi Publications Pvt. Ltd, New Delhi, 2nd Ed, 2017	978-8170-0899-19
2	Automotive Mechanics	Crouse W.H., Anglin D.W; Tata-McGraw Hill Publications, Delhi, 5th Ed, 2006	978-0070-6343-50
3	Automobile Engineering (vol. I & II)	Dr. Kirpal Singh, Standard Publishers, New Delhi.(2004), 13th Ed, 2020	978-8180-1419-66 978-8180-1420-82
4	Automobile Engineering	H. M. Sethi, Tata-McGraw Hill, 1st Ed, 2006	978-0074-6039-01
5	Automotive Mechanics	S Shrinivasan, Tata-McGraw Hill, 2nd Ed, 2017	978-0070-4949-16
6	Automobile Engineering	T. R. Banga, Nathu Singh, Khanna publishers, 1st Ed, 2005	978-8174-0922-12

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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	2	1	1	2	1	1
CO2	2	3	2	1	1	1	2	1	1
CO3	2	2	2	2	1	2	1	1	1
CO4	2	2	3	3	3	1	1	1	1
CO5	2	2	2	2	1	2	1	1	1
CO6	2	3	2	1	1	1	2	1	1

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Coordinator, Head of Department

Curriculum Development, Department of Mechanical Engineering

Department of Mechanical Engineering

I/C, Curriculum Development Cell Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: **ME19403**				Course Title: **Mathematics for Mechanical Engineers**						
Compulsory / Optional: Optional										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs. 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	60	20	20	**--**	**--**	25	**125**

Abbreviations: TH- Theory; PR-Practical; TU-Tutorial; TS1 and TS2- Term Tests; OR-Oral Exam; TW: Term Work (progressive assessment), * Indicates assessment by External Examiner else internal assessment
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Engineering problems can effectively expresses in terms of mathematics. Mathematics is a tool to optimize many issues. If students are aware of applications of mathematical techniques, they can analyse the issues and derive optimum solutions. Hence it is apt to learn application oriented study of mathematical techniques.

Many students having analytical approach can develop their skills with this course. The course is designed to make student understand the practical applications of mathematical techniques.

Course Outcomes: Student should be able to

CO1	Solve first order first degree differential equations of various types
CO2	Apply the concept of Cayley-Hamilton theorem to solve various problems.
CO3	Apply Laplace transform to solve differential equation of first order with constant coefficients
CO4	Utilize Basic concepts of probability distribution to solve elementary engineering problems
CO5	Sketch the Curves
CO6	Solve Double and triple integrals

Course Content Details:

Unit No	Topics / Sub-topics
1	**1. Differential Equations** 1.1 Definition of Differential Equation 1.2 Order and Degree of Differential Equation 1.3 Formation of Differential equation for function containing single constant 1.4 Solution of first order first degree differential equation-(i) variable separable (ii) equation reducible to variable separable form(iii) Homogeneous (iv) Exact (v) linear **Course Outcome: CO1 Teaching Hours: 08 Marks : 12 (R-4, U-4, A-4)**

Unit No	Topics / Sub-topics
2	2. Matrices 2.1 Vectors, real field Inner products, Norm, Linear independence, Orthogonality. 2.2 Characteristic values and vectors, their properties for Hermitian and real symmetric matrices. 2.3 Characteristic Polynomial 2.4 Cayley Hamilton theorem 2.5 Functions of square matrix 2.6 Minimal polynomial 2.7 Diagonalizable matrix **Course Outcome: CO2 Teaching Hours: 09 Marks: 12 (R-4, U-4, A-4)**
3	**3. Laplace Transformation** 3.2.1 Definition ,Laplace transform of elementary functions 3.2.2 Important properties of Laplace Transform-Linearity property ,first shifting property, second shifting property, change of scale property 3.2.3 Important results-multiplication by t^n and division by t (without proof) 3.2.4 Inverse Laplace Transform 3.2.5 Properties of Inverse Laplace transform- Linearity and first shifting Property 3.2.6 Inverse Laplace transform by partial fraction 3.2.7 Application of Laplace transform for solving differential equations of first order with constant coefficients **Course Outcome: CO3 Teaching Hours: 11 Marks: 16 (R-4, U- 4, A-8)**
4	**4. Probability Distribution** 4.1 Probability Distribution 4.1.1 Discrete probability Distribution 4.1.2 Continuous probability Distribution 4.2 Basics of statistics and Binomial Distribution 4.3 Poisson Distribution 4.4 Normal Distribution **Course Outcome: CO4 Teaching Hours: 07 Marks: 08 (R- 4, U-2, A-2)**
5	**5. Curve Tracing** 5.1 Introduction 5.2 Important Points 5.3 Method of Tracing a Curve 5.4 Standard Curves 5.5 Parametric Equation 5.6 Polar Co-ordinates 5.7 Polar Equations **Course Outcome: CO5 Teaching Hours: 06 Marks: 06 (R-2, U-2, A-2)**
6	**Double and Triple Integration** 6.1 Introduction to Double Integral 6.2 Evaluation of Double Integral 6.3 To Calculate the Double Integral over a given region 6.4 Introduction to Triple Integral 6.5 Evaluation of Triple Integral **Course Outcome: CO6 Teaching Hours: 4 Marks: 06 (R-2, U-2, A-2)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Differential Equations	4	4	4	12
2	Matrices	4	4	4	12
3	Laplace Transformation	4	4	8	16
4	Probability Distribution	4	2	2	8
5	Curve Tracing	2	2	2	6
6	Double and Triple Integration	2	2	2	6
	Total	20	18	22	60

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	**Assignment on concept of calculus and differentiation:** ➢ Use of exact differential for identifying intensive and extensive property in thermodynamics ➢ Use of differentiation in finding condition for maximum efficiency of a characteristic curve. ➢ Application of differentiation in smoothening the curve	04
2	1	CO1	**Application of first order differential equation to real world systems:** ➢ First order differential equations used in damping system and vibration of springs ➢ Heat transfer problems and Euler's equation ➢ Proof of pascals law in fluid mechanics for three dimensional analysis etc.	04
3	2	CO2	**Assignment on Matrices:** ➢ Problems on metrics, scalar and vector product ➢ Use of stiffness metrics and tensor metrics using vector approach	04
4	2	CO2	**Application of metrices in security information science:** ➢ Use of cryptography and ➢ Encryption process with certain examples	04
5	3	CO3	Problems on Laplace Transformation and inverse Laplace transform	02
6	3	CO3	Application of Laplace transform to solve the increasing complexity of engineering problems for example its applications which make differential equations easy to solve.	04
7	4	CO4	**Assignment on basics of Statics** :	04

Sr. No.	Unit No	COs	Title of the Experiments	Hours
			➢ Collection of data, Comparison of Mean, Median and Mode with certain application, analyzing data, ➢ Use and application of statistical charts used in the industries.	
8	5	CO6 and CO5	**Application of Integration and curve tracing**: ➢ To find Torque required to overcome the friction considering uniform wear and pressure condition ➢ To find the work done for Isobaric, Iso thermal and adiabatic process. ➢ To identify and plot different conic sections ➢ Use of MathCad to draw the Polar curves	04
Total				**30**

Note: All experiments/assignments are compulsory

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mathematics for Polytechnic Students II	S. P. Deshpande, Pune Vidyavardhini Graha Prakashan, 9th Ed, 2015	978-8193-4140-88
2	Applied Engineering Mathematics (Volume II)	H.K.Dass, Dr.Rama Verma, S, Chand Publication, 8th Ed, 2009	978-8121-9316-63
3	Companions to Engineering Maths	G. V. Kumbhojkar, P. Jamunadas LLP, 2nd Ed, 2017	978-8193-4656-15
4	Applied Mathematics	N.Raghvendra Bhatt, Mohan Singh, Tata McGraw Hill Publication, 1997	978-0074-6044-34
5	Higher Engineering Mathematics	B. S. Grewal, Khanna Publications, 40th Ed, 2010	978-8174-0919-56

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9. https://www.vedantu.com/ncert-solutions/ncert-solutions-class-12-maths
10. MYCBSEGUIDE

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	2	2	1	1	1	3	3	1
CO2	3	2	2	1	1	1	3	3	1
CO3	3	2	2	1	1	1	2	3	1
CO4	3	2	2	1	1	1	3	2	1
CO5	3	2	2	1	1	1	3	3	1
CO6	3	2	2	1	1	1	2	3	1

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Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME 19404				Course Title: **Non-Conventional Energy Resources**						
Compulsory / Optional: Optional										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hr 30 min)	TS1 (1 Hr)	TS2 (1 Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**-**	**--**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rational:

The energy has become an important and one of the basic infrastructures for the economic development of the country. It is imperative for the sustained growth of the economy. This course envisages the new and renewable source of energy, available in nature and to expose the students on sources of energy crisis and the alternates available, also stress up on the application of non-conventional energy technologies.

Course Outcomes: At the end of the course student will be able to:

CO1	Describe the Non-Conventional sources of energy.
CO2	Identity & Describe application of Solar energy technology.
CO3	Describe application of solar thermal system.
CO4	Describe application of Wind energy technology.
CO5	Describe Biomass application & its maintenance.
CO 6	Apply principles of energy measurement & conservation.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Conventional and Non-conventional Energy Resources** 1.1 Conventional energy sources 1.1.1 Change-Green House Gases, Global Warming 1.1.2 Sustainable growth. 1.1.3Present Energy Scenario: Global and Indian 1.2 Non-conventional energy sources 1.3 Need of non conventional energy sources.

Unit No	Topics / Sub-topics
	1.4 Renewable Sources of Energy such as Hydro, Solar, Wind, Bio-mass, Tidal and Geothermal – their availability 1.5 Energy Consumption in Household Appliances. **Course Outcome:CO1 Teaching Hours:06 Marks:10 (R-4, U-4, A-2)**
2	**Solar Energy Technology** 2.1 Solar Radiation, Sun & Earth, Solar Spectrum, Sun & Earth Movement, Solar Geometry: Concept 2.2 Solar Thermal Applications, Water Heating, Space Heating, Space Cooling and Refrigeration, Power Generation, Distillation **Course Outcome: CO2 Teaching Hours:08 Marks:10 (R-2, U-4, A-4)**
3	**Solar Thermal System** 3.1 Construction Details containing capacity, size and materials for Solar Flat Plate Collector, Solar Evacuated Flat plate Collector, Solar Concentrating Collector, Solar Cooker-Box and Concentrating Solar Drying 3.2 Solar Photovoltaic Conversions: Principle of working of Solar cell Construction Details containing capacity, size & materials of Solar Photovoltaic System **Course Outcome: CO3 Teaching Hours: 08 Marks:12(R-2, U-4, A-6)**
4	**Wind Energy Technology** 4.1 Wind Power, Concepts of Wind Energy Conversion, Lift and Drag, Classification and Description, Components of Power Generating Horizontal Axis Wind Turbine, Site Selection Criteria. **4.2** Hydro-Power Site Selection, Different Components of Small Hydroelectric Projects, Types of Turbine-Francis, Propeller, Classification of Small Hydro-electric Plants: Ultra low head, Low head, Medium/high head, Micro hydro, Mini hydro, Small hydro **4.3 Introduction to Tidal Energy:** 4.3.1 Basic principle of tidal power plant. 4.3.2 Components of tidal power plant 4.3.3 Advantages and Disadvantages **Course Outcome: CO4 Teaching Hours: 08 Marks:10 (R-2, U-4, A-4)**
5	**Biomass Energy Technology** 5.1 Introduction to biomass and farm residue, management and briquetting 5.2 Bio-gas as a source of energy. Benefits of bio-gas 5.3 Technology of biogas 5.4 Principles, feedstock, types and design of biogas plants 5.5 Comparison of plant designs 5.6 Main parts of biogas plants, digester, gas holder, pressure gauge, gas controlling cocks and meter 5.7 Selection of biogas model and size. Site selection of Plants 5.8 Appliances of biogas plant - burner, heating plate, lamps

Unit No	Topics / Sub-topics
	5.9 Operation, trouble shooting and maintenance of biogas plant 5.10 Safety measures in biogas plant. Biomass Gasification, Different types of biomass gasifies. **Course Outcome: CO5 Teaching Hours:08 Marks:10(R-2, U-4, A-4)**
6	**Energy Measurement and Conservation** 6.1 Energy Measurement and Instruments: Lux meters, Pyranometer, Sunshine Recorder, Pyrheliometer, Combustion analyzer **6.2** Energy Conservation: Energy Efficiency-Boiler & Furnace Efficiency, Waste Heat Recovery Systems, Energy Loss Prevention-Thermal Insulation **6.3** Energy Consumption **6.4** Energy Audit- Definition, Need of Energy Audit, Types of Energy Audit. **Course Outcome: CO6 Teaching Hours:07 Marks:08 (R-2, U-2, A-4)**

Level of questions:
R: Remember, U: Understand, A: Apply

Suggested Specifications Table (Theory):

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Conventional & Non-conventional Energy Resources	4	4	2	10
2	Solar Energy Technology	2	4	4	10
3	Solar thermal system	2	4	6	12
4	Wind Energy Technology	2	4	4	10
5	Biomass Energy Technology	2	4	4	10
6	Energy Measurements and conservation	2	2	4	8
	Total	**14**	**22**	**24**	**60**

List of Experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Collect information about global and Indian energy market from websites and prepare write-up	4
2	2	CO2	Visit to a commercial or Industrial Solar water heating Installation. Writing a report about collector layout, piping and fittings and measurement of performance of the system.	4
3	3	CO3	Collect information about photovoltaic array used for an application such as pumping, home lighting etc. making use of energy instruments.	4

Sr. No.	Unit No	COs	Title of the Experiments	Hours
4	4	CO4	Study of a Small Hydraulic Power plant. Write about location, capacity, efficiency, construction and working of the plant	4
5	4	CO4	Study construction and working of horizontal axis wind mill or to visit a nearest wind farm and write a report.	2
6	5	CO5	Visits to a biogas plant or biomass gasification facility. Writing a report on plant structural details and components. Measurement of performance.	4
7	6	CO 6	Assignment on Calculation Of Energy Consumption of Household Appliances (Fan, T.V.Washing Machine, Geyser etc) and prepare Report.	4
8	6	CO 6	Conducting walk through energy audit of a small establishment such as workshop/Office/Home/SSI unit.	4
		Total		**30**

References/ Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Non conventional energy sources	G.D.Rai, Khanna Publishers, New Delhi, 6th Ed, 1988	978-8174-0907-37
2	Solar energy, Principles of Thermal Collection & Storage	S.P.Sukhatme, J. Nayak,Tata McGraw Hill Publishing Co.Ltd. Delhi, 3rd Ed. 1996	978-9387-0961-58
3	Biogas Technology- A practical Handbook, Vol 1	K.C. Khandelwal, S.S.Mahdi, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 1993	978-0074-5172-39
4	Solar photovoltaic fundamentals & Applications	Chetansingh Solanki, PHI Learning Pvt.Ltd. New Delhi, 3rd Ed, 2015	978-8120-3511-10
5	Non-Conventional Energy Resources	B.H.Khan, Mc Graw Hill Publishing Co. Ltd, New Delhi, 3rd Ed, 2017	978-0070-6065-48
6	Guide Book for National Certification for Energy Managers and Energy Auditors, Book 1 – General Aspects of Energy Management and Energy Audit	Bureau of Energy and Efficiency (BEE)	--

E-References:

Website of Bureau of Energy and Efficiency (www.bee-india.nic.in)

- **Energy management (www.energymanagertraining.com)**
- **http://nptel.ac.in/courses/112105051/**
- **https://www.youtube.com/watch?v=3dJAtHaSQ98**
- **https://www.youtube.com/watch?v=xokHLFE96h8**
- **http://www.tatapower.com/businesses/renewable-energy.aspx**
- **http://www.cleanlineenergy.com/technology/wind-and-solar**

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	1	1	1	1	1	2	2	1	1
CO2	2	1	1	3	1	2	2	2	3
CO3	3	2	2	3	1	2	3	2	3
CO4	2	3	2	2	1	2	3	1	3
CO5	2	3	2	3	1	2	3	2	3
CO6	3	2	2	3	1	2	3	2	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Dharme G.S.	Workshop Superintendent	Agnel Polytechnic, Bandra, Mumbai
2	Mr. Mane M.A.	Assistant Professor	Suman Ramesh Tulsiani Technical Campus Kamshet, Pune
3	Mr.Raut N.N.	Deputy General Manager-Operations	Sunrise Industries (India) Limited,Vadodara
4	Ingle D.R.	Directional Drilling Engineer	Jindal Drilling & Industries Ltd. Mumbai
5	Mr. Jamnik Y.B.	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
6	Mr. Dhembare E.C.	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:**ME19304**				Course Title: **Power Engineering and Refrigeration & Air Conditioning**						
Compulsory / Optional: **Compulsory**										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min.)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	---	---	**25**	**125**

Abbreviations: TH- Theory; PR-Practical; TU-Tutorial; TS1 and TS2- Term Tests; OR-Oral Exam; TW: Term Work (progressive assessment), * Indicates assessment by External Examiner else internal assessment
Note: For Minimum passing marks under various heads, refer, examination rule AR26.

Rationale:

Power producing and absorbing devices are essentials for mechanical engineering. It is necessary for technologists to analyze working and monitor the performance of devices like internal combustion engines, air compressors, gas turbines and steam turbines. This knowledge is also useful in selecting suitable prime mover for given application and to maintain and test the same. The diploma holders in Mechanical Engineering are responsible for supervising and maintenance of Refrigeration& Air Conditioning systems. For this purpose, the knowledge and skill covering basic principles of refrigeration and air conditioning is required to be imparted to the students, which play a vital role in maintaining controlled atmosphere in different domestic and industrial applications.

Course Outcomes: Student should be able to-

CO1	Identify different components and test the performance of I.C. Engine.
CO2	Maintain reciprocating air compressors.
CO3	Describe working and applications of steam turbines and steam condensers.
CO4	Identify different components of gas turbine and jet engines.
CO5	Test the performance of refrigeration and air-conditioning systems.
CO6	Make basic calculations of psychometric properties and processes.

Course Content Details:

Unit No	Topics / Sub-topics
1	**IC Engines and Testing of IC Engines** 1.1 **Internal Combustion Engines:** Assumptions made in air standard cycle, Brief description of Carnot, Otto and Diesel cycles with P-V and T-S diagrams, Internal and external combustion engines; advantages of I.C. engines over external combustion engines, classification of I.C. engines, neat sketch of I.C. engine indicating component parts, Function of each part and materials used for the component parts - Cylinder, crank case, crank pin, crank, crank shaft, connecting rod, wrist pin, piston, cylinder heads, exhaust valve, inlet valve, Working of four-stroke and two-stroke petrol and diesel

Unit No	Topics / Sub-topics
	engines, Comparison of two stroke and four stroke engines; Comparison of C.I. and S.I. engines, Valve timing and port timing diagrams for four stroke and two stroke engines. 1.2 **Engine Systems:** Fuel system of Petrol engines; Principle of operation of simple and Zenith carburetors, Fuel system of Diesel engines; Types of injectors and fuel pumps, Cooling system- air cooling, water cooling system with thermo siphon method of circulation and water cooling system with radiator and forced circulation (description with line diagram). Comparison of air cooling and water cooling system; Ignition systems – Battery coil ignition and magneto ignition (description and working). Comparison of two systems; Types of lubricating systems used in I.C. engines with line diagram; Types of governing of I.C. engines – hit and miss method, quantitative method, qualitative method and combination methods of governing; their applications; Objective of super charging 1.3 **Performance of I.C. Engines:** Brake power; Indicated power; Frictional power; Brake and Indicated mean effective pressures; Brake and Indicated thermal efficiencies; Mechanical efficiency; Relative efficiency; Performance test; Morse test; Heat balance sheet; Methods of determination of B.P., I.P. and F.P., Simple numerical problems on performance of I.C. engines. Concept of pollutants in SI and CI engines, pollution control norms for two and four wheelers, BS4 and BS6. Engine Control Unit (ECU): working and diagnosis procedure **Course Outcome: CO1 Teaching Hours: 12 Marks: 12 (R-2, U-4, A-6)**
2	**Air Compressors** 2.1 Functions of air compressor – uses of compressed air, types of air compressors, Construction and working of Single stage and two stage reciprocating air compressor, intercooling, representation of processes involved on PV diagram, calculation of work done 2.2 Testing of reciprocating air compressors: Pressure ratio, compressor capacity, FAD, volumetric efficiency, isothermal efficiency, numerical. Methods of energy saving. 2.3 Rotary compressors – types, descriptive treatment of centrifugal compressor, axial flow compressor, vane type compressor. Comparison of rotary with reciprocating **Course Outcome: CO2 Teaching Hours:06 Marks:08 (R-2, U-2, A-4)**
3	**Steam Turbines and Steam Condensers** 3.1 Function and use of steam turbine, Steam nozzles - types and applications Steam turbines - impulse, reaction, construction and working principle, governing of steam turbines, 3.2 Function of a steam condenser, elements of condensing plant, Classification - jet condenser, surface condenser 3.3 Cooling pond and cooling towers types **Course Outcome: CO3 Teaching Hours:05 Marks:06 (R-2, U-2, A-2)**

Unit No	Topics / Sub-topics
4	**Gas Turbines and Jet Propulsion** 4.1 Types of gas turbine: Classification, open cycle gas turbine and closed cycle gas turbine, PV and TS diagram and working of gas turbine. Brayton cycle, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbine. 4.2 Jet Propulsion :Principle of operation of turbojet, turboprop, ram-jet engine , application of jet engines 4.3 Rocket propulsion: liquid and solid propellant systems, rocket fuels. **Course Outcome: CO4 Teaching Hours:04 Marks:06 (R-2, U-2, A-2)**
5	**Introduction to Refrigeration** 5.1 Refrigeration systems: Basic Components, Flow diagram of working of Vapor compression cycle; Representation of the vapor compression cycle on P-H, T-S & P-V Diagram; Expression for Refrigerating effect, work done and power required; Types of Vapor Compression cycle; Effects of super heating and under cooling, its advantages and disadvantages; Simple Vapor absorptions cycle and its flow diagram; Simple Electrolux system for domestic units; Comparison of Vapor absorption and vapor compression system; Simple problems on vapor compression cycle 5.2 Refrigeration equipments: Compressor - types of compressors; Hermetically sealed and Semi hermetically sealed compressor; Condensers - Air Cooled, water cooled, natural and forced draught cooling system; Advantages and disadvantages of air cooled and water cooled condensers; Evaporators -natural, convection, forced convection types. 5.3 Refrigerants and lubricants: Introduction to refrigerants; Properties of good refrigerants; Classification of refrigerants by group number and commonly used refrigerants in practice; Detection of refrigerants leakage; Charging the system with refrigerant; Lubricants used in refrigeration and their properties 5.4 Refrigerant flow controls: Capillary tube; Automatic Expansion valve; Thermo static expansion valve; High side and low side float valve; Solenoid valve; Evaporator pressure regulator 5.5 Safety Devices-Thermostat, overload protector LP, HP cut out switch. 5.6 Application of refrigeration: Slow and quick freezing; Cold storage and Frozen storage; Dairy refrigeration; Ice making industry; Water coolers. 5.7 Procedure of collecting refrigerant and charging of refrigerant during maintenance (pumping down) **Course Outcome: CO5 Teaching Hours:10 Marks:16 (R-4, U-6, A-6)**
6	**Air conditioning** 6.1 Air conditioning: Introduction to Air conditioning; Factors affecting Air conditioning; specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT, sensible heat, latent heat, total enthalpy of air. Psychometric chart and its use; Psychometric process-sensible heating and cooling, Humidifying and dehumidifying; Adiabatic saturation process; Equipments used in air conditioning cycle; Air conditioning units and

Unit No	Topics / Sub-topics
	plants. Window air-conditioning, split type air-conditioning, car air-conditioning and central air-conditioning. 6.2 Latest development in refrigeration and air conditioning, Inverter technology, auto-defrosting, blast cooling, star rating. 6.3 Refrigeration and Air-conditioning tools: Tools used in refrigeration and Air conditioner installation; Installation procedure; Faults in refrigeration and air conditioning system; Servicing procedure. **Course Outcome: CO6 Teaching Hours:08 Marks:12 (R-4, U-4, A-4)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**IC Engines and Testing of IC Engines.**	2	4	6	12
2	**Air Compressors**	2	2	4	08
3	**Steam Turbines and Steam Condensers**	2	2	2	06
4	**Gas Turbines and Jet Propulsion**	2	2	2	06
5	**Introduction to Refrigeration**	4	6	6	16
6	**Air conditioning**	4	4	4	12
	Total	**16**	**20**	**24**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Assemble/dismantle 4 stroke petrol or diesel engine.	02
2	1	CO1	Assemble/dismantle 2 stroke petrol or diesel engine.	02
3	1	CO1	Perform test on the given I.C. Engine to prepare heat balance sheet.	04
4	1	CO1	Perform Morse test on the given I.C. Engine.	04
5	1	CO1	Use exhaust gas analyzer to measurement and analyze pollutants in the given I.C Engine.	02
6	2	CO2	Perform test on the two stage reciprocating air compressor to find volumetric and isothermal efficiency.	04
7	3	CO3	Assemble/dismantle steam turbine and steam condenser model.	02
8	4	CO4	Assemble/dismantle gas turbine model.	02

9	5	CO5	Perform test on vapor compression refrigeration cycle test rig to find COP.	04
10	6	CO6	Demonstration and working of split type and window type air-conditioner.	02
11	6	CO6	Visit to an ice plant or cold storage plant. Or central air conditioning plant.(If possible)	02
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Internal combustion engines	Mathur M.I., Sharma R.P.; Dhanpatrai Publication (P)Ltd, New Delhi, 8th Ed, 2012	978-8189-9284-69
2	Thermal Engineering	Rajput R.K, Laxmi Publications New Delhi, 9th Ed., 2010	978-8131-8080-47
3	A Textbook of Internal Combustion Engines	Rajput R.K, Laxmi publications, New Delhi, 3rd Ed., 2016	978-8131-8006-69
4	IC Engines combustion and Emissions	Pundir B.P, Narosa Publishing House, New Delhi, 2nd Ed, 2010	978-8184-8708-79
5	Refrigeration and Air Conditioning	Khurmi R.S, Gupta J.K; S. Chand Publication, New Delhi, 4th Ed, 2016	978-8121-9278-19
6	Thermal Engineering	Singh Sadhu, Pati Sukumar, Pearson Education, New Delhi, 1st Ed.; 2018	978-9352-8666-87
7	Engineering Thermodynamics	PK Nag; Tata McGraw Hill, Delhi, 6th Ed; 2008	978-9352-6064-29
8	Engineering Thermodynamics	CP Arora, Tata McGraw Hill, New Delhi, 1st Ed., 2001.	978-0074-6201-44

E-References:

1. https://swayam.gov.in/
2. www.youtube.com
3. https://learnengineering.org/
4. https://nptel.ac.in/

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	1	1	1	1	2	1
CO2	2	2	1	1	1	1	1	2	2
CO3	3	2	2	2	1	1	1	2	3
CO4	3	3	3	2	2	1	1	2	3
CO5	3	3	3	2	2	1	1	2	3
CO6	3	3	3	2	2	1	1	2	3

Industry Consultation Committee:

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1	Mr. A.G. Joshi	Lecturer in Mechanical Engineering	Government Polytechnic, Ahmednagar
2	Mr. Mahesh Mahadik	Sr. Project Engineer	Atlas Copco India Ltd. Pune
3	Mr. Amol S. Dhawade	Lecturer in Mechanical Engineering	Indira Gandhi Polytechnic, Belwandi (Sugar), Ahmadnagar
4	Mr. Vaibhav Patil	MEO Class IV, Marine Engineering Officer	Sea World Management Ltd. Monaco Italy.
5	Mr. E.C. Dhembare	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
6	Mr. Y.B.Jamnik	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME 19306				Course Title: Advanced Manufacturing Processes						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min.)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**25***	**--**	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rationale:

After getting conversant with basic manufacturing processes, it is necessary for technician to know about the area of advanced manufacturing processes. This course will impart knowledge for working in modern manufacturing environment. It will also help to familiarize with working principles, operations performed on non-traditional machining, surface finishing, plastic processing and machine tools. To keep pace with the current industrial scenario, this course will introduce the learner to applications of robots in manufacturing. The course also contains the topics as machine tool erection, commissioning and maintenance.

Course Outcomes: Student should be able to:

CO1	Describe construction and applications of shaper, planer and Special Purpose Machines.
CO2	Describe Non- traditional machining processes and Rapid Prototyping Techniques
CO3	Describe various plastic processing techniques and steps in powder metallurgy
CO4	Describe the applications of robots in manufacturing
CO5	Describe various super finishing and surface modification techniques.
CO6	Describe machine tool erection, commissioning, and maintenance procedure.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Shaper, Planer and Special Purpose Machines** 1.1. Specifications of shaper, construction & Working, Whitworth quick return mechanism, Operations performed on planer 1.2. Types of Planning Machine, Specifications of planer, Working mechanism, Operations performed on planer

Unit No	Topics / Sub-topics
	1.3. **Special Purpose Machines (SPM):** Need, Different layouts of SPM, Advantages and Limitations, Types of SPMs, Difference between general purpose machine and SPM **Course Outcome: CO1 Teaching Hours:05 Marks: 10 (R-2, U-4, A-4)**
2	**Non-Traditional Machining Processes & RPT** 2.1 Need, Classification, Comparison with traditional machining processes 2.2 Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Electro-Discharge Machining (EDM), Laser Beam Machining (LBM)- Working principle, process parameters, Advantages, Limitations, and Applications 2.3 Rapid Prototyping: Need, Classification, Stereo Lithography, Selective Laser Sintering (SLS). Fused Deposition Modeling- working principle, Advantages and Applications **Course Outcome: CO2 Teaching Hours:09 Marks: 10 (R-2, U-4, A-4)**
3	**Plastic Processing and Powder Metallurgy** 3.1 Types of Plastics: Thermosetting, Thermoplastic plastics, Materials for processing plastics 3.2 Elastomer: properties and engineering applications of Natural rubber, butadiene rubber, silicone rubber 3.3 Plastic Processing: Working principle and applications of Compression moulding, Transfer moulding, Injection Moulding, Calendaring, Extrusion, Thermo-forming, Blow moulding 3.4 Safety Practices in plastic industry 3.5 Powder Metallurgy: Need, steps and applications, Advantages & Limitations **Course Outcome: CO3 Teaching Hours:07 Marks: 08 (R-2, U-2, A-4)**
4	**Applications of Robots in Manufacturing** 4.1 Need of robots in manufacturing, Classification of robots 4.2 Robot anatomy, 4.3 Applications of robots for material handling, welding, assembly, painting and inspection 4.4 Robot Safety **Course Outcome: CO4 Teaching Hours:05 Marks: 08 (R-2, U-4, A-2)**
5	**Super-Finishing Operations** 5.1 Need of super-finishing processes 5.2 Working principle and application of Honing, Lapping, Polishing, Buffing 5.3 Process parameters for Honing, Lapping, Polishing, Buffing 5.4 Surface enhancement processes: Need, Working principle and applications of Burnishing, shot peening **Course Outcome: CO5 Teaching Hours:05 Marks: 08 (R- 0, U-4, A-4)**

Unit No	Topics / Sub-topics
6	**Machine Tool Maintenance** 6.1 Need, objectives of maintenance of machine tools, Tools and Instruments required for maintenance **6.2** Types of maintenance, Basic maintenance practices for simple machine elements viz. bearings, couplings, shafts, pulleys, gear, chain and belts **6.3** Repair cycle Analysis, Maintenance records. Spare parts management, Maintenance Planning **6.4** Total Productive Maintenance-Principles, advantages, role of supervisor & workers **Course Outcome: CO6 Teaching Hours:07 Marks: 08 (R-2, U-2, A-4)**
7	**Erection and Commissioning of Machine Tools** 7.1 Need of foundation for Machine Tools, Foundation plans , Types of foundation bolts, Types of machine foundations, 7.2 Machine Erection, Installation and Leveling **Course Outcome: CO6 Teaching Hours:07 Marks: 08 (R-2, U-4, A-2)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Shaper, Planer and Special Purpose machines	2	4	4	10
2	Non-Traditional Machining Processes & RPT	2	4	4	10
3	Plastic Processing and Powder Metallurgy	2	2	4	8
4	Application of Robots in Manufacturing	2	4	2	8
5	Super-Finishing Operations	-	4	4	8
6	Machine Tool Maintenance	2	2	4	8
7	Erection and Commissioning of Machine Tools	2	4	2	8
	Total	**12**	**24**	**24**	**60**

List of Jobs/ Assignments:

Sr. No.	Unit No	CO	Title of the Experiments/Assignment	Hours
1	1	CO1	One Job on shaper in the group of four students	4
2	2	CO2	Industrial visit/ video to observe at least one non-traditional machining process and report writing	4
3	2	CO2	Industrial visit/ video to observe rapid prototyping technique and report writing	4
4	3	CO 3	Demonstration of one plastic/ elastomer (rubber) processing technique	2
5	4	CO4	Industrial visit/ video to observe robotic application in manufacturing industry and report writing	4
6	5	CO 5	Industrial visit/ video to observe superfinishing operation in manufacturing industry and report writing	4
7	6	CO6	To prepare preventive maintenance chart for at least one machine in workshop	4
8	6	CO6	Preparation of foundation plan for given machine	4
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Production Technology, Vol 2	O.P. Khanna, Dhanpat Rai & Co., 4th Ed, 2012	978-9383-1820-39
2	Non -Conventional machining	P. K. Mishra, Narosa Publishing House, 7th Ed, 1997	978-8173-1913-81
3	Elements of Workshop Technology Vol. II (Machine Tools)	Hajra Chawdhury, Media Promotors and Publications Pvt. Ltd. 15th Ed, 2008	978-8185-0991-56
4	Industrial Maintenance	H. P. Garg, (Revised by Bhagawati Gupta),S. Chand Publication, Revised Ed, 2010	978-8121-9016-80
5	Production Engineering	P. C. Sharma S. Chand Publications, 4th Ed, 1999	978-8121-9011-16
6	Production Technology	Hindustan Machine Tools Tata McGraw Hill, 2001	978-0070-9644-33

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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	2	1	1	2	2	1
CO2	3	3	2	3	1	1	2	2	3
CO3	2	1	2	2	1	1	2	2	2
CO4	1	1	3	1	2	1	2	3	2
CO5	2	2	3	3	2	2	3	3	3
CO6	2	3	2	3	1	2	2	2	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Puralkar Mohanish	Manager, R & D	Miles Ahead Tech Pvt. Ltd, Mumbai
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5	Mr. Joshi S. V.	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
6	Mr. Ansari N N	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

-

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19307				Course Title: Production and Industrial Engineering						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**-**	**-**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Manufacturing involves resources like men material and machines. All these resources are to be used in such that produce is ready at a proper time, quality as per customer requirement, at most competitive price. This is only possible when all the resources are used in a most productive way. This course will expose the students, the concept of productivity, production systems production planning, work study and modern production system.

This course will help students to take the right decisions to optimize resources utilization by improving productivity and manage effectively, to eliminate unproductive activities and design of products and processes, to use the charts to record, the activities of the people, materials and equipment to find alternative methods which minimizes waste and to implement the best method.

Course Outcomes: Student should be able to

CO1	Interpret production systems and productivity and plant layout.
CO2	Prepare the process plan for given job
CO3	Describe the production planning and control functions and modern techniques of production control.
CO4	Apply the techniques and tools for method stud
CO5	Apply the techniques and tools for time study
CO6	Describe the principles of motion economy & ergonomics

Course Content Details:

Unit No	Topics / Sub-topics
1	**Production Systems & Plant Layout** 1.1 Types of Production Systems-Batch production, Job Production and Continuous production system, and their comparison 1.2 Productivity: Definition of productivity, Labour productivity, Material productivity and Machine productivity. Methods of improving productivity

Unit No	Topics / Sub-topics
	1.3 Plant Layout: Objectives, Types of plant layout, Principles of plant layout design, Factors affecting plant layout, Symptoms of bad plant layout **Course Outcome: CO1 Teaching Hours:08 Marks: 10 (R-2, U-4, A-4)**
2	**Process planning** 2.1 Process planning for a product, Sequence of operations, Operation sheet 2.2 Types of operations, Combining of operations 2.3 Determination of inspection stages **Course Outcome:CO2 Teaching Hours:07 Marks: 10 (R-2, U-4, A-4)**
3	**Production Planning and Control (PPC) & Modern production control Techniques** 3.1 Importance and definition of PPC, Functions of PPC, 3.2 Operation routing, Job Sequencing (n jobs and 2 machines) 3.3 Gantt chart, Line balancing 3.4 Production economics, Elements of costing 3.5 Just in time system, Kanban, Lean manufacturing system, Flexible manufacturing system, Kaizen **Course Outcome:CO3 Teaching Hours: 08 Marks: 10 (R-2, U-4, A-4)**
4	**Method Study** 4.1 Definition and objectives of method study, Procedure of method study, Selection of work for method study 4.2 Charting techniques: Outline process chart, Flow process chart, , Flow diagram, Travel chart 4.3 Critical examinations and analysis, primary and secondary questions, Comparison of present and proposed methods **Course Outcome:CO4 Teaching Hours: 08 Marks:10 (R-2, U-4, A-4)**
5	**Time Study** 5.1 Definition and objectives of time study. Procedure, Equipment required to conduct time study, 5.2 Factors affecting rate of work, Types of elements, Rating and allowances, 5.3 Calculation of standard time 5.4 Introduction to Maynard Operation Sequencing Technique (MOST) **Course Outcome:CO5 Teaching Hours:07 Marks:10 (R-2, U-4, A-4)**
6	**Principle of motion economy & Ergonomics** 6.1 General considerations related to human body, tools and equipment and work place layout. 6.2 Two handed process chart, Multiple activity chart, THERBLIGS 6.3 Definition, importance and objectives of ergonomics, Man- machine system and its three aspects

Unit No	Topics / Sub-topics
	6.4 Design of information display, Design of controls, and environmental factors **Course Outcome:CO6 Teaching Hours:07 Marks:10 (R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Production Systems & Plant Layout**	2	4	4	10
2	**Process planning**	2	4	4	10
3	**Production Planning and Control (PPC) & Modern production control Techniques**	2	4	4	10
4	**Method Study**	2	4	4	10
5	**Time Study**	2	4	4	10
6	**Principle of motion economy & Ergonomics**	2	4	4	10
	Total	**12**	**24**	**24**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Design of plant layout for manufacturing of given product (In group of 4 students)	4
2	1	CO1	Assignment on production systems and productivity	2
3	2	CO2	Preparation of Process plan and operation sheet for given component (In group of 4 students)	4
4	3	CO3	Preparation of PPC documents for assigned product	2
5	3	CO3	Assignment on job sequencing and line balancing	2
6	4	CO4	Preparation of outline process chart and flow process chart for the assigned task	2
7	4	CO4	Method study for the existing system and improved system for performing assigned task	4
8	5	CO5	To conduct time study for a assigned activity	4
9	5	CO5	Case study on application of MOST	2
10	6	CO6	Preparation of two handed process chart for the given task	2
11	6	CO6	Ergonomic analysis of man-machine system on any machine in workshop	2
		Total		**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Introduction to Work Study	International Labor Organization, Geneva, Oxford & IBH, 4th Revised Ed, 2015	978-8120-4060-25
2	Production Planning and Control	L C Jhamb, Everest Publishing House, 7th Ed, 2002	978-8186-3142-41
3	A Text Book of Production (operations) Management	L C Jhamb, Everest Publishing House, 7th Ed, 2002	978-8186-3142-41
4	Industrial Engineering and Management	O. P. Khanna, Dhanpatrai Publications, 2018	978-8189-9283-53
5	Industrial Engineering and Production Management	Martand Telsang, S. Chand Publisher, 2nd Revised Ed, 2006	978-8121-9177-35

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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	2	1	1	2	3	1
CO2	2	3	2	1	1	1	2	2	2
CO3	3	2	2	2	1	1	2	1	1
CO4	3	2	2	1	2	1	2	3	3
CO5	2	2	2	3	2	1	3	3	2
CO6	2	2	2	2	2	2	2	2	2

Industry Consultation Committee:

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2	Mr. Rao Virbhadra	Assistant Professor	Fr. C.R. College of Engg., Mumbai
3	Mr. Puralkar Mohanish	Manager R & D	Miles Ahead Tech Pvt. Ltd. Mumbai
4	Mr. Joshi S. V.	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
5	Mr. Ansari N N	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
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Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19312				Course Title: Basics of Mechatronics						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	--	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

The integration of Mechanical Engineering, Electrical Engineering, Electronics Engineering, Computer Technology and Control Engineering is increasingly forming a crucial part in the design, manufacture and maintenance of wide range of engineering products and processes. As a consequence, there is a need for a diploma engineers to understand systems used in automation. This course gives exposure to understand the basics of mechatronics.

Course Outcomes: Student should be able to

CO1	Identify various components of measuring systems.
CO2	Identify different sensors for various control system applications.
CO3	Use of OPAMP, Actuators and Switches.
CO4	Describe functional elements of mechatronics involved in CNC and other applications.
CO5	Describe procedure for installation and troubleshooting of PLC
CO6	Describe the elements of MEMS

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Measurement** **1.1** Measuring systems and their components. **1.2** Static and dynamic characteristics **1.3** Measuring errors **1.4** Open loop system and closed loop system, applications of closed loop systems **1.5** Control action – proportional, integral, derivative, PI, PD, PID **Course Outcome: CO1 Teaching Hours :06 Marks: 06 (R-2, U-4, A-0)**
2	**Sensors and their applications** **2.1** Sensors & Transducers-classification of sensors pertaining to the application in manufacturing. **2.2** Displacement sensors, position sensors &Proximity sensor, Eddy current proximity sensor,

Unit No	Topics / Sub-topics
	2.3 Velocity and motion sensors **2.4** Force sensors – Strain gauges **2.5** Pressures sensors – Diaphragm, Piezoelectric sensor, Tactile sensor, **2.6** Potentiometer sensor, Inductive proximity sensor, Optical encoder, Pneumatic sensor, Light sensor. **Course Outcome: CO2 Teaching Hours:08 Marks: 12 (R-4, U-6, A-2)**
3	**Signal Processing** **3.1** Amplification/ Attenuation – Operational amplifier types (OPAMP)- Inverting, Voltage follower, Adder, Subtractor, Integrator **3.2** Amplifier types & need of filter – low pass filter, high pass filter, band pass filter, band reject filter **3.3** Types of I/P – step I/P, ramp I/P **3.4** Actuators- Mechanical, Hydraulic and Pneumatic **3.5** Limit switches, Thumb wheel switches, Relays, Solenoids, Stepper motor and Servo motor **Course Outcome: CO3 Teaching Hours: 07 Marks: 12 (R-4, U-6, A-2)**
4	**Mechanical aspects of Mechatronics** **4.1** Definition of Mechatronics **4.2** Importance of mechatronics in automation – flow diagram for the operations involved in manufacturing of a product. **4.3** Mechatronics system - functional elements of mechatronics **4.4** Basic Mechanical aspects of Mechatronics **4.5** Linear motion drives used in CNC machines **4.6** Tool monitoring systems in CNC machines **Course Outcome: CO4 Teaching Hours: 09 Marks:12 (R-4, U-6, A-2)**
5	**Programmable Logic Controller** **5.1** Introduction, PLC definition, PLC block diagram, Difference between relay panel and PLC. **5.2** Input/output modules (Analog, digital), concepts of sink/source, latch/unlatch, advantages and disadvantages of PLC. **5.3** Installation, troubleshooting and maintenance of PLC. **5.4** Networking of PLC. **5.5** Introduction to microprocessor and microcontroller **5.6** Data convention devices- Comparators, Encoders, ADC, DAC **Course Outcome: CO5 Teaching Hours:10 Marks: 12 (R-4, U-6, A-2)**
6	**Mechatronics Systems** **6.1** MEMS (Micro electro mechanical systems) **6.2** Elements of MEMS. **6.3** Applications, advantages of MEMS **6.4** Micromachining **Course Outcome: CO6 Teaching Hours: 05 Marks: 06 (R-2, U-4, A-0)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Measurement	2	4	-	06
2	Sensors and their applications	4	6	2	12
3	Signal Processing	4	6	2	12
4	Mechanical aspects of Mechatronics	4	6	2	12
5	Programmable Logic Controller	4	6	2	12
6	Mechatronics Systems	2	4	-	06
	Total	**20**	**32**	**8**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify different types of Mechatronics system built in automated machine tools.	04
2	2	CO2	Assignment on sensors & transducers.	02
3	3	CO3	Assignment on OPAMP & actuators.	04
4	3	CO3	Identify various electro pneumatic systems in material handling automation module.	04
5	4	CO4	Assignment on mechanical aspects of Mechatronics.	04
6	5	CO5	Maintenance of PLC of any automation system.	04
7	6	CO6	Assignment on micromachining.	04
8	-	CO1-CO6	Industrial visit to any Automated plant.	04
Total				**30**

Note: All the experiments are compulsory.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mechatronics Handbook HMT	HMT, Tata McGraw Hill P,1st Ed., 2000	978-0074-6364-35
2	Mechatronics-Electronic control systems in Mechanical and Electrical Engineering	Bolton W, Pearson Education Ltd, 4th Ed; 2010	978-8131-7325-33
3	Introduction to Mechatronics and Measurement systems	Histand B. H. & Alciatore D. G, Tata McGraw Hill Publishing, 4th Ed., 2002	978-0071-1955-77
4	Programmable Logic Controllers	John W. Webb & Ronald Reis, Prentice Hall of India, 5th Ed., 2002	978-8120-3230-87
5	Programmable Logic Control-Principles and Applications	NIIT Prentice Hall of India, 1st Ed., 2004	978-8120-3252-58
6	Mechatronic Systems Design	Kolk R. A; Shetty D. Vikas Publishing, New Delhi, 2nd Ed., 2010	978-1439-0619-85
7	Mechatronics Principle, Concepts and applications	Mahalik N. P. Tata McGraw hill Publishing, 1st Ed., 2014	978-0070-4837-43

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12. https://www.youtube.com/watch?v=Ro_tFv1iH6g
13. https://www.youtube.com/watch?v=oxMdDsud5vg

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	2	1	2	1	3	2	1
CO2	2	2	3	2	2	2	3	2	2
CO3	3	2	3	3	2	2	3	3	2
CO4	3	2	3	3	2	2	3	3	2
CO5	3	3	3	2	3	2	3	3	2
CO6	3	3	3	2	3	2	3	3	2

Industry Consultation Committee:

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4	Mr. Gajanan Gore	Lecturer in Mechanical Engineering	Government Polytechnic Jalna
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Head of Department
Department of Mechanical Engineering

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Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

P19 Curriculum

Fifth Semester

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -V**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19405 ME19406 ME19407	**Optional Course-II** ***(Select any One)*** TOOL ENGINEERING INDUSTRIAL MAINTENANCE INVENTORY CONTROL	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19310	METROLOGY & QUALITY CONTROL	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19305	CNC MACHINES & AUTOMATION	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19302	INDUSTRIAL HYDRAULICS AND PNEUMATICS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19311	DESIGN OF MACHINE ELEMENTS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19303	SOLID MODELING	--	4	--	4	4	--	--	--	25*	--	25	**50**
ME19308	PROJECT	--	4	--	4	4	--	--	--	--	50*	50	**100**
ME19501	ENTREPRENUERSHIP DEVELOPMENT & MANAGEMENT	--	2#	--	2	2	--	--	--	--	--	--	**--**
	Total	**15**	**20**	**--**	**35**	**35**	**300**	**100**	**100**	**50**	**50**	**200**	**800**
Total Contact Hours					**35**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral,TW: Term Work (progressive assessment)

* Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, @ indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
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Dept. of Mechanical Engineering

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19405				Course Title: Tool Engineering						
Compulsory / Optional: Optional										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**-**	**-**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26.

Rationale:

Engineering Manufacturing industry uses conventional machining processes on large scale. Technicians/ supervisors are required to possess knowledge and skills regarding selection of tooling & their geometry, selection of machining parameters, design or use of jigs, fixtures and press tools. The accuracy and economy of machining depends on the application of appropriate machining strategies.

In this context, the mechanical engineering diploma student must be well versed with tool materials, tool geometry, coolants, principles of jig/ fixtures design, press tool design etc. Also the student can find out specialized career option in the field of tool engineering.

Hence it is apt to study this course with the objective to develop the competency of selection of appropriate tooling.

Course Outcomes: Student should be able to

CO1	Select appropriate tool materials and cutting fluids
CO2	Apply basics of theory of metal cutting for given conditions
CO3	Choose proper tool geometry for single point cutting tools, twist drills, reamers and milling cutters
CO4	Design and use press tools for various operations
CO5	Develop and use the jigs and fixtures for given components
CO6	Develop basic features of forging die for given simple component

Course Content Details:

Unit No	Topics / Sub-topics
1	**Tool Materials & Cutting Fluids** 1.1 Need to develop newer tool materials, Desired properties of tool materials, Tool materials, their composition, and applications- HSS, Cemented Carbides, Coated carbides, Cast alloy tools, Ceramics, Cermets, CBN, Diamond 1.2 Heat zones in metal cutting, Desired properties of cutting fluids, Functions of cutting fluids, Types of cutting fluids, Factors considered in selection of cutting fluids, Cutting fluid maintenance, Methods of applications of coolants, mist as coolant, MQL, Dry machining Environmental issues with cutting fluids **Course Outcome: CO1 Teaching Hours: 06 Marks:10(R-2, U-4, A-4)**

Unit No	Topics / Sub-topics
2	**Theory of Metal Cutting** 2.1 Parameters: Speed, feed, depth of cut, Types of chips and factors responsible for formation, Concepts of Orthogonal & Oblique cutting, Chip thickness ratio, determination of shear angle, shear stress, Graphical determination of velocities in orthogonal cutting, 2.2 Forces in orthogonal cutting, Merchant's Circle construction and graphical estimation of various forces, angle of friction 2.3 Tool wear, types of tool wear, Tool life definition, Taylor's Equation of tool life, factors affecting tool life/ tool wear 2.4 Machinability: Definition, factors affecting machinability, Machinability Index, Surface finish & accuracy possible with various machining processes **Course Outcome: CO2 Teaching Hours:08 Marks:10(R-2, U-4, A-4)**
3	**Cutting Tool Geometry** 3.1 Tool geometry of single point cutting (SPC) tool, definitions and functions of various tool angles, Tool signature, Classification of SPC tools, Design of single point cutting tool, surface finish generated by SPC tool, Designation code of carbide inserts 3.2 Milling Cutter: Elements and Tool geometry of plain milling cutter, up milling, down milling, specifications of milling cutters 3.3 Twist Drills & Reamers: Elements & geometry of twist drill and reamer, specifications of drills & reamers 3.4 Various types of tool holders **Course Outcome: CO3 Teaching Hours:06 Marks:10(R-2, U-4, A-4)**
4	**Press Tool Design** 4.1 Sheet metal operations, Shearing, Clearance between die and punch, angular clearance, Calculation of blanking force and estimation of press capacity for blanking, Method of reducing punching force by providing shear on die and punch, Elements of press tools & their functions, Types of press tools- Simple, Progressive, compound, combination, scrap stripe layout for blanking operation, percent utilization of stock, center of pressure 4.2 Drawing, deep drawing, Estimation of drawing force, Percent reduction, Calculation of blank size, defects in drawing operation & remedies 4.3 Bending: Bending allowance, Spring back, Calculation of bending force 4.4 Materials for manufacture of press tools components 4.5 Safety in press operations, Maintenance & repairs of dies, **Course Outcome: CO4 Teaching Hours:10 Marks:10(R-2, U-4, A-4)**
5	**Jigs & Fixtures Design** 5.1 Definition of Jig, fixture, Need and advantages, Parts of jigs/ fixtures, Considerations in Jig/ fixture design, Principles of Location, Locating elements, tolerance on locating elements, Use of diamond pin locator, Principles of clamping, clamping elements, Indexing elements, Fool proofing of jigs and fixtures 5.2 Drill Jig types, Types of bushes, Development of jig for given component operation, clearances on bush, 5.3 Types of fixtures, Development of fixture for given component operation 5.4 Introduction to Jigs/ fixtures for Aerospace industry, fluidized bed fixtures, modular fixtures 5.5 History cards for all types of cutting tools, dies and J & F for maintenance & regrinds **Course Outcome:CO5 Teaching Hours:10 Marks:10(R-2, U-4, A-4)**

Unit No	Topics / Sub-topics
6	**Forging Die Design** 6.1 Types of forging, Advantages and limitations of forging, Applications **6.2** Types of forging dies, Constructional features of forging dies, materials for forging dies **6.3** Factors considered in design of forging dies **6.4** Types of Impressions in drop forging dies, Graphical method for developing edging impression **6.5** Development of simple forging die for drop forging and upset forging **Course Outcome:CO6 Teaching Hours:05 Marks:10(R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Tool Materials & Cutting Fluids**	2	4	4	10
2	**Theory of Metal Cutting**	2	4	4	10
3	**Cutting Tool Geometry**	2	4	4	10
4	**Press Tool Design**	2	4	4	10
5	**Jigs & Fixtures Design**	2	4	4	10
6	**Forging Die Design**	2	4	4	10
	Total	**12**	**24**	**24**	**60**

List of experiments/ Assignments:

Sr. No.	Unit No	COs	Title of the Experiments/ Assignment	Hours
1	1	CO1	Determination of cutting fluid mixture composition and architecture of cutting fluid handling system of the machine tool	2
2	2	CO2	Graphical estimation of forces & velocities in metal cutting	2
3	3	CO3	Design of Single Point Cutting Tool and SPC tool grinding	4
4	4	CO4	Development of scrap stripe layout (Group Activity)	4
5	4	CO4	Design of simple blanking die (Press Tool) (Group Activity)	4
6	5	CO5	Development of Drilling Jig (Group Activity)	4
7	5	CO5	Development of Fixture (Group Activity)	4
8	6	CO6	Development of drop/ upset forging die for given component (Group Activity)	4
9	4	CO4	Evaluation of drawability of sheet metal by Erichsen Cupping test	2

Sr. No.	Unit No	COs	Title of the Experiments/ Assignment	Hours
10	4	CO4	Design of Drawing Die (Group Activity)	2
Total				**30**

Note: For group activities, size of group should be 3-4 students. Experiments No. 1 to 8 are compulsory, Minimum 09 experiments/ assignments shall be completed. Remaining experiments are to be performed as per importance of the topic/ availability of time. Teacher may arrange the industry visit/ expert lecture as instructional strategy.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Tool Engineering & Design	Nagpal G. R.; Khanna Publishers, 6th Ed, 2006	978-8174-0920-38
2	Tool Design	Cyril Donaldson, George H Lecaine, VC Goold, McGraw Hill Education; 4th Ed, 2012	978-0070-1539-29
3	A Text Book of Production Engineering	P.C. Sharma, S. Chand, 4th Ed, 2009	978-8121-9011-16
4	Manufacturing Technology, Vol 2, Metal cutting and machine tools	P. N. Rao, Tata McGraw-Hill Education, 2nd Ed, 2013	978-1259-0625-75
5	Jigs and Fixtures	P. H. Joshi, Tata McGraw Hill, 3rd Ed, 2010	978-1259-0612-26
6	Production Technology	HMT, McGraw Hill Education, 2017	978-0070-9644-33

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3. http://astakhov.tripod.com/MC/Cutting-Fluids.pdf
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6. http://staff.uny.ac.id/sites/default/files/pendidikan/aan-ardian-mpd/1g-handbook-die-design-2nd-edition.pdf
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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	2	3	3	3	3
CO2	3	2	2	3	2	2	3	2	2
CO3	3	3	3	3	3	2	3	3	3
CO4	3	3	2	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3
CO6	3	1	2	3	3	3	3	3	2

Industry Consultation Committee

Sr. No	Name	Designation	Institute/Organisation
1	Shri. Uday Kudtarkar	Sr. DGM (Tool Engineering)	L&T Ltd, Powai
2	Shri. Samir B. Shah	Director	Emkey Fastners, Thane
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4	Shri. S. T. Patil	Director	Friends Engineering, Pune
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7	Dr. Ketan Jagtap	Lecturer in Mechanical Engineering	Government Polytechnic, Vikramgad
8	Shri. U.A. Agnihotri	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
9	Dr. V.U.Rathod	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
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Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19406				Course Title: Industrial Maintenance						
Compulsory / Optional: Optional										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**--**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR 26.

Rationale:

Maintenance is one of the important functions in any type of industry. Also every mechanical engineer should be aware of basic principles of maintenance and maintenance management. With the advancements in manufacturing processes, machine tools and other service sectors, the employment opportunities in the field of maintenance are increasing.

This course in industrial maintenance provides the opportunity to students to get familiar with the maintenance procedures of simple mechanical systems/ components, basics of maintenance management and new approaches like TPM, 5S.

Course Outcomes: Student should be able to

CO1	Describe basic terminology in maintenance practices
CO2	Describe & select appropriate maintenance strategy for given equipment
CO3	Describe basics of TPM & 5S
CO4	Describe the procedure for the maintenance of given mechanical systems or components
CO5	Describe the spares management norms for maintenance and describe lubrication activities
CO6	Describe the documentation used in maintenance activities in industries.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basics of Maintenance Engineering** 1.1 Definition, Need & Importance of maintenance, basic terminology related to maintenance- Mean time between failure (MTBF), mean time to repair (MTTR), Terotechnology, Reliability 1.2 Objectives and functions of maintenance department, consequences of equipment failures 1.3 Costs of maintenance 1.4 Organizational structure for maintenance, skills required for maintenance activities **Course Outcome: CO1 Teaching Hrs: 06 Marks:06 (R-2, U-4, A-0)**
2	**Maintenance Systems/ Maintenance Strategies** 2.1 Factors considered in deciding criticality of equipment, Maintenance Plan Preparation,

Unit No	Topics / Sub-topics
	2.2 Maintenance strategies, their characteristics and applications: Break down/ corrective maintenance, Preventive maintenance, Condition based maintenance (CBM), Reliability based maintenance, equipments used for CBM 2.3 Equipment Life cycle- Bath Tub Curve and maintenance strategies, Factors considered in maintenance system design 2.4 Preparation of maintenance schedule for preventive maintenance, maintenance cycle, Preparing Check list for PM **Course Outcome: CO2 Teaching Hrs :08 Marks:12 (R-4, U-4, A-4)**
3	**Total Productive Maintenance (TPM)** 3.1 Philosophy of TPM, Six losses due to inferior maintenance, Concept of Autonomous Maintenance 3.2 Objectives and Benefits of TPM, Overall Equipment Efficiency (OEE) 3.3 Stages of implementation of TPM, Pillars of TPM 3.4 5S & its implementation **Course Outcome: CO3 Teaching Hrs:07 Marks:08(R-2, U-4, A-2)**
4	**Maintenance of Mechanical Systems & Components** 4.1 Maintenance of bearings, clutches, couplings, flexible drives, gears & gear drives, shafts 4.2 Maintenance of Pumps, Air Compressors, Condensers 4.3 Maintenance of Pneumatic systems: Common problems in pneumatic systems, Maintenance schedule of pneumatic systems 4.4 Maintenance of hydraulic Systems: Common problems in hydraulic systems, Maintenance schedule of hydraulic systems 4.5 Maintenance of Conveyors, Overhead Hoists, cranes 4.6 Safety in maintenance activities, Energy saving through planned Maintenance **Course Outcome: CO4 Teaching Hrs:12 Marks:16 (R-4, U-8, A-4)**
5	**Spares Management & Lubrication** 5.1 Classification of spares, norms for stock, stock of electrical spares, 5.2 Lubrication, different methods of lubrication 5.3 Lubricants, function of Lubricant, Properties of Lubricant, Types of Lubricant **Course Outcome: CO5 Teaching Hrs:06 Marks:10 (R-4,U-4,A-2)**
6	**Documentation for maintenance Activities** 6.1 Maintenance requisition Procedure, Work order, work permit system 6.2 Maintenance Manual, History Cards, Defect analysis, Down time analysis **Course Outcome: CO6 Teaching Hrs: 06 Marks:08 (R-0, U-4, A-4)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basics of Maintenance Engineering	2	4	-	6
2	Maintenance systems/ Maintenance strategies	4	4	4	12
3	Total Productive Maintenance	2	4	2	8
4	Maintenance of mechanical systems and components	4	8	4	16
5	Spare management and lubrication	4	4	2	10
6	Documentation for maintenance activities	-	4	4	8
	Total	**16**	**28**	**16**	**60**

List of experiments/ Assignments:

Sr. No.	Unit No	COs	Title of the Experiments/ Assignment	Hours
1	1	CO1	Assignment on basics of maintenance engineering	2
2	2	CO2	Preparation of check list for preventive maintenance for assigned equipment/ machine in workshop or laboratory	4
3	3	CO3	Assignment on TPM/ Assignment on 5S	4
4	4	CO4	Performance of maintenance activity for assigned equipment/ machine (Group activity) & preparation of activity report	4
5	5	CO5	Preparation of lubrication schedule for assigned equipment/ machine and its implementation during term	4
6	6	CO6	Assignment on documentation for maintenance activities	2
7	1-6	CO1-CO6	Mini Project on assigned maintenance related activity in the group of four students [students to work throughout term and present work]	4
8	1-6	CO1-CO6	Expert lecture by maintenance professional or visit to maintenance department in industry	2
9	2	CO2	Condition based maintenance- using the equipments for measurement of signatures	4
10	4	CO4	Performance of maintenance activities on pneumatic systems	4
11	4	CO4	Performance of maintenance activities on hydraulic systems	4
		Total		**30**

Note: Experiments No. 1 to 8 are compulsory, Minimum 10 experiments/ assignments shall be performed.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Maintenance and spare parts management	P. Gopalkrishnan, A. K. Banerji, Prentice Hall of India, 2nd Ed; 2004	978-8120-3066-91
2	Principles and practice of Total Productive Maintenance	Bikash Bhadury, Allied Publishers Ltd, 1st Ed; 1998	978-8170-2380-58
3	Pneumatic Systems Principles and Maintenance	S.R. Mujumdar, Tata McGraw Hill Publishing Company Ltd, 1st Ed; 1995	978-0074-6023-17
4	Maintenance Fundamentals	R. Keith Mobley, Elsevier Butterworth–Heinemann, 2nd Ed., 2004	978-0750-6779-81
5	Industrial Maintenance	H P Garg, S Chand & company,3rd Ed., 1987	978-8121-9016-80
6	Plant maintenance engineering	R K Jain, Khanna publications, 2nd Ed; 2018	978-8174-0929-46
7	Maintenance engineering and management	R.C. Mishra and K Pathak, Prentice Hall of India Pvt. Ltd, New Delhi, 12th Ed; 2004	978-8120-3457-37
8	Total productive maintenance	K. S. Madhavan, Shingo institute of Japanese management, 1st Ed; 2014	978-8190-6715-52
9	Engineering maintenance- A modern approach	B. S. Dhillon, CRC Press, 1st Ed; 2002	978-1587-1614-21

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2. https://www.youtube.com/watch?v=f58SW0Hwcf0
3. https://www.youtube.com/watch?v=6Zh8_x17qhI
4. https://www.youtube.com/watch?v=foq43sPPmMo
5. https://easyengineering.net/me6012-maintenance-engineering/
6. www.sasurieengg.com/e-course-material/MECH/IV-Year%20Sem%208/ME2037%20ME.pdf
7. https://www.coursehero.com/file/46869813/ME6012-ME-Complete-Notespdf/

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	2	1	2	1	3	2	1
CO2	2	2	3	2	2	2	3	2	2
CO3	3	2	3	3	2	2	3	3	2
CO4	3	2	3	3	2	2	3	3	2
CO5	3	3	3	2	3	2	3	3	2
CO6	3	3	3	2	3	2	3	3	2

Industry Consultation Committee

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Coordinator, Head of Department
Curriculum Development, Department of Mechanical Engineering
Department of Mechanical Engineering

I/C, Curriculum Development Cell Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:ME19407				Course Title: Inventory Control						
Compulsory / Optional: Optional										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**-**	-	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26.

Rationale:

Engineering Manufacturing industry uses numerous types of inventories. Technicians/ supervisors are required to possess knowledge and skills regarding monitoring and controlling the inventories as inventories have direct impact on economics of manufacturing and continuity of manufacturing. Any person working in industry must be sensitive about inventory levels, their role in manufacturing, especially in modern manufacturing strategies like just in time systems.

In this context, the mechanical engineering diploma student must be well versed with techniques of inventory control, store operations, 5S etc. Also the student can find out specialized career option in the field of materials management, stores and purchase department.

Hence it is apt to study this course with the objective to develop the competency of selection of appropriate techniques of inventory control.

Course Outcomes: Student should be able to

CO1	Identify inventories and estimate EOQ/ EMQ
CO2	Apply the techniques of selective inventory control
CO3	Select appropriate replenishment system
CO4	Identify and apply control measures for WIP and basic understanding of ERP working
CO5	Apply procedures of stores activities
CO6	Apply Monte Carlo method of simulation for inventory management, 5S technique

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basics of Inventory Control** 1.1 Need and objectives of Inventory Control, Symptoms of Poor Inventory control, Financial and operational effects of over and under inventory levels, Definitions: Inventory, Lead Time , Types of inventories, Seasonal, Decoupling, pipeline Inventories, Need of integrated approach for inventory control 1.2 Various costs associated with Inventory Carrying Cost, Procurement Cost, Set-up Cost, 1.3 Economic Order Quantity (EOQ), Economic Manufacturing Quantity (EMQ), with and without discounts **Course Outcome: CO1 Teaching Hours: 08 Marks: 10 (R-2, U-4, A-4)**

Unit No	Topics / Sub-topics
2	**Selective Control of Inventories** 2.1 ABC Analysis: Objective & Procedure 2.2 XYZ Analysis: Objective & Procedure 2.3 FSN Analysis: Objective & Procedure 2.4 VED Analysis: Objective & Procedure 2.5 Deciding strategy for control using combining ABC & XYZ and XYZ –FSN classification **Course Outcome:** CO2 **Teaching Hours: 07** **Marks: 10 (R-2, U-4, A-4)**
3	**Replenishment Systems** 3.1 Elements of Lead Time, Factors affecting Lead time, Safety Stock, Need and factors affecting safety stock, 3.2 Elements of Replenishment System: Reorder Quantity, Reorder Level, minimum level stock, Lead time consumption, Maximum stock, minimum stock, average inventory, Need for periodic review of replenishment system parameters 3.3 Fixed order quantity system, features, working, parameters, Limitations, suitability, Modification (Two Bin system) 3.4 Fixed-Order – Interval System, parameters, suitability, modification with fixed order quantity **Course Outcome: CO3** **Teaching Hours:08** **Marks:10 (R-2, U-2, A-6)**
4	**Inventory Control of Work in Process (WIP) & ERP** 4.1 Reasons for WIPs, Effects of increased WIP, factors influencing quantity of WIP, Manufacturing Cycle Efficiency 4.2 Strategies for reduction in WIP in Job, Batch, mass, Process manufacturing 4.3 Role of line manager in controlling WIP 4.4 Enterprise Resource Planning (ERP) - Concept, Need, objectives, modules, advantages & Limitations of ERP **Course Outcome: CO4** **Teaching Hours:07** **Marks: 10 (R-2, U-4, A-4)**
5	**Store procedures and management** 5.1 Purpose of store, Responsibilities and functions of store officer 5.2 Procedures for Materials receipt, Inspection, Issue, record keeping, interrelation with materials management department 5.3 Stock Verification: Need, Reasons for deviation between physical stocks and documented stock, Methods of stock verification: Annual stock taking, Continuous stock taking, Re-order point stock taking **Course Outcome: CO5** **Teaching Hours:07** **Marks: 10 (R-4, U-6,A-Nil)**
6	**Simulation and 5S** 6.1 Monte Carlo Method applied to inventory problems 6.2 Elements of 5S method, types of wastes, need, Implementation requirements 6.3 Recycling & reuse **Course Outcome: CO6** **Teaching Hours:08** **Marks: 10 (R-2, U-2, A-6)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basics of Inventory Control	2	4	4	10
2	Selective Control of Inventories	2	4	4	10
3	Replenishment Systems	2	2	6	10
4	Inventory Control of Work in Process (WIP) & ERP	2	4	4	10
5	Store procedures and management	4	6	-	10
6	Simulation, 5S	2	2	6	10
	Total	**14**	**22**	**24**	**60**

List of experiments: All practical/assignments are compulsory

Sr. No.	Unit No	COs	Title of the Assignments/Experiments	Hours
1	1	CO1	Case Studies on EOQ and EMQ Estimation	04
2	2	CO2	Case Studies on Selective Inventory Control	04
3	3	CO3	Case studies on Replenishment Systems	04
4	4	CO4	Case studies on Work in Process	04
5	5	CO5	Assignment on functioning of Industrial Stores and documentation	04
6	6	CO6	Case studies on use of Simulation in formulating Inventory Control problems	04
7	1	CO1-6	Mini Project (Group Activity) Teacher to identify topics and assign topics to self formed groups	02
8	2	CO4	Hands-on on Inventory control module of any free ERP software or Development of excel sheet for given requirements of a small enterprise for Inventory control	04
	Total			**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Inventory Management	L. C. Jhamb, Everest Publishing House, 18th Ed, 2005	978-8186-3145-48
2	Materials Management: An integrated approach	P. Gopalkrishnan, M. Sundaresan, PHI Learning Pvt. Ltd. 33rd Ed, 2011	978-8120-3002-79
3	Purchasing And Inventory Management	K. S Menon , Sarika Kulkarni, Shroff Publishers; 1st Ed, 2011	978-8184-0470-66
4	Computer-Aided Production Management	P. B. Mahapatra, Prentice-Hall of India Pvt.Ltd, Ed, 2004	978-8120-3174-20

5	Operations Management for competitive advantage	Richard B. Chase, F. Robert Jacobs, Nicholas J. Aquilano, Nitin K. Agarwal, Tata McGraw Hill, 11th Ed, 2006	978-0070-6044-83

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3. https://afifnurichwan.files.wordpress.com/2015/06/inventory-control-and-management-second-edition.pdf
4. https://www.iibms.org/wp-content/uploads/2015/05/essentials_of_inventory_management.pdf

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	2	-	2	2	3	2	2
CO2	3	2	2	3	3	2	2	2	2
CO3	3	3	2	3	2	2	2	2	2
CO4	3	2	2	3	2	2	2	2	2
CO5	3	-	-	-	3	2	3	2	2
CO6	3	-	3	2	2	2	1	2	2

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5	Dr. H.P. Khairnar	Associate Professor	VJTI, Mumbai
6	U.A. Agnihotri	Lecturer in Mechanical Engineering	Govt. Polytechnic Mumbai
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Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:ME19310				Course Title: Metrology & Quality Control						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**-**	**5**	**60**	**20**	**20**	**25***	-	**25**	**150**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR 26.

Rationale:

Engineering industry uses variety of manufacturing processes. and processing different engineering materials, metals as well as non-metals. Mechanical engineering technicians require knowing the different types of measuring instrument to be used in variety of situation. While working in different domains of mechanical engineering, technicians shall possess the competence to select appropriate measuring instruments and quality control tools for required applications productively.

In this context, the mechanical engineering diploma student must be well versed with different types of measuring instrument to be used in variety of situations. Also the student is required to have hands on learning experience on different types of measuring instruments.

In the present global competitive scenario, an industry can only survive and flourish when its customers are satisfied. This satisfaction comes with quality product and services. This course imparts necessary knowledge so that students can perform the job of quality control supervisor effectively.

Hence it is apt to study this course with the objective to develop the competency of selection, use and applications of measuring instruments and various quality control tools.

Course Outcomes: Student should be able to

CO1	Describe the terminology related with metrology and calibration requirements
CO2	Select and use of suitable measuring instruments for linear measurement and describe construction, working and applications of comparators.
CO3	Use instruments for angle measurement and thread measurement.
CO4	Interpret tolerances, fits and design Go-No Go gauges from given data and perform machine tool alignment testing
CO5	Select and use of suitable measuring instruments for surface roughness and flatness
CO6	Describe the elements of Quality management, TQM, Six Sigma and apply the technique of statistical quality control, acceptance sampling and estimation of process capability

Course Content Details:

Unit No	Topics / Sub-topics
1	**Basics of Engineering Metrology** 1.1 Disciplines of Metrology: Scientific metrology, industrial metrology and Legal Metrology, Measuring characteristics of instruments & their significance: Least count, range, precision, accuracy, repeatability, sensitivity 1.2 Traceability and calibration: Need of Calibration, General requirements for the competence of testing and calibration laboratories (as per ISO 17025 - 2017 and NABL-129 related with dimensional metrology, Types and Sources of errors in measurement, concept of uncertainty 1.3 Types of standards: Line standard, End standard and wavelength standard, their comparison. **Course Outcome: CO1 Teaching Hours: 06 Marks: 10 (R-2, U-4, A-4)**
2	**Linear measurement and Comparators** 2.1 Basic Measuring Instruments: Principle, construction and application/operation of Vernier calipers, Micrometer, Height gauge, Feeler gauges, Radius gauges, Screw pitch gauges, Slip gauges: specification, wringing and combination, Applications of slip gauges 2.2 Definition and Classification of comparators, requirements of good comparator 2.3 Working and applications of comparators: Dial indicator, Sigma comparator, Pneumatic Comparator **Course Outcome:** CO2 **Teaching Hours: 06 Marks: 10 (R-2, U-4, A-4)**
3	**Angular Measurement** and **Thread Measurement** 3.1 Concept of angle measurements, Working and use of universal bevel Protractor, Sine Bar, Sine Centre, Sine table and Spirit Level 3.2 Principle and Working of Clinometers, Angle dekkor, Angle Gauges: combination for setting required angle 3.3 Definitions and measurement of different thread elements such as major diameter, minor diameter, effective diameter, pitch for external threads 3.4 Construction, working and use of Thread Micrometer, floating carriage micrometer, Errors in threads, Pitch errors **Course Outcome: CO3 Teaching Hours:07 Marks:10 (R-2, U-4, A-4)**
4	**Gauge Design and Machine Tool Testing** 4.1 Concept of Limits, Fits, And Tolerances, interchangeability, Hole and Shaft Basis System (IS-919-1993), Tolerance staking: worst scenario method and SD method 4.2 Classification of gauges, Taylor's Principle for gauge design, Design of Go-No Go Gauges from given data 4.3 Concept of Parallelism, Straightness, Squareness, Roundness, Run out 4.4 Alignment Test: Significance of alignment tests, Tools required, Procedure of alignment tests for Lathe, milling machine and drilling machine as per IS standard **Course Outcome: CO4 Teaching Hours:07 Marks: 10 (R-2, U-4, A-4)**

Unit No	Topics / Sub-topics
5	**Surface Roughness, Flatness Testing and Modern Metrology** 5.1 Terminology as per IS 3073- 1967, , CLA, Ra, RMS values and their interpretation, 5.2 Various techniques of qualitative analysis 5.3 Talysurf roughness tester: construction and working 5.4 Principles of interferometry, Use of Optical flat for flatness testing 5.5 Introduction to laser metrology 5.6 Coordinate measuring machines (CMM): Construction, working and industrial applications. **Course Outcome: CO5 Teaching Hours:05 Marks: 10 (R-2, U-4,A-4)**
6	**Quality Tools and Quality Management** 6.1 Definitions of quality and quality control, Quality characteristics, Quality of design, Quality of conformance, Quality of performance, Quality cost & its components, Comparison between Quality assurance and Quality Control, Inspection: Need, Types of inspection. Inspection stages, 6.2 Principles and concept of 'Total Quantity Management', Quality Audit, and its type, Six sigma concept, Needs of quality standards, Introduction of ISO 9001 recent version, Revision of quality standards 6.3 **Statistical Quality Control:** Significance of SQC, Variables and attributes, Population and sample, Causes of variation assignable and random variations. Normal distribution curve. 6.4 Control charts: Plotting of Control charts for variables (X & R charts), control charts for attributes (P, C charts), selection of appropriate type of chart, Process capability: estimation (Cp & Cpk), interpretation: Statistically capable and in capable processes. 6.5 Acceptance Sampling: Concept of sampling inspection, Comparison with 100% inspection, Different types of sampling plans, IS 4905-1968, working of various sampling plans, factors affecting on selection of sampling plan, Operating Characteristic Curve. consumer's risk and producer's risk **Course Outcome: CO6 Teaching Hours:14 Marks: 10 (R-2, U-4, A-4)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Basics of Engineering Metrology	2	4	4	10
2	Linear measurement and Comparators	2	4	4	10
3	Angular Measurement and Thread Measurement	2	4	4	10
4	Gauge Design and Machine Tool Testing	2	4	4	10
5	Surface Roughness, Flatness Testing and Modern Metrology	2	4	4	10
6	Quality Tools and Quality Management	2	4	4	10
	Total	**12**	**24**	**24**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Assignments/Experiments	Hours
1	-	-	Know your laboratory (Safety, care and maintenance)	2
2	1,2	CO1, CO2	Calibration Procedure for Vernier Caliper and Micrometer	2
3	2	CO2	Use of basic measuring instruments: Surface plate, V-block, feeler gauge, radius gauge, thread gauge and height gauge	2
4	2	CO2	Inspection of components using Pneumatic comparator	2
5	2	CO2	Use of dial indicator as mechanical comparator	2
6	3	CO3	Angle measurement using Sine bar	2
7	3	CO3	To measure major diameter, minor diameter, effective diameter, using floating carriage diameter measuring machine/thread micrometer.	2
8	3	CO3	To measure major diameter, minor diameter, pith, depth of thread and thread angle using profile projector/ Tool Maker's Microscope	2
9	4	CO4	Assignment on Gauge Design	2
10	4	CO4	Alignment testing on center lathe / drilling machine	2
11	5	CO5	Surface flatness characterization using optical flats	2
12	6	CO6	Construct X,R chart and interpret the results/ Plotting of control chart for variables	2
13	6	CO6	Construct P/C- chart and interpret the results/ Plotting of control chart for attributes	2
14	6	CO6	Sampling Inspection	2
		Total		**30**

Note: Any 11 experiments covering all COs

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Engineering Metrology	R. K. Jain, Khanna Publisher, Delhi, 22nd Ed; 2015	**978-8189-4012-69**
2	Text Book of Metrology	M. Mahajan, Dhanpat Rai & Co; 4th Ed, 2012	**978-8177-0005-11**
3	Text Book of Metrology	I.C. Gupta, Dhanpat Rai & Co; 4th Ed, 2018	**978-8189-9284-52**
4	Statistical Quality Control	M. Mahajan, Dhanpat Rai & Co.4th Ed, 2016	**978-8177-0006-58**
5	Statistical Quality Control	Douglas C Montgomery, Students' Resource Manual, Wiley India Pvt. Ltd. 5th Ed; 2002	**978-0471-6781-06**
6	Total Quality Management	Dale H. Besterfield and others, Pearson, Revised Ed, 2011	**978-0130-9930-69**

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CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	2	3	2	2	3	3
CO2	3	2	3	3	3	3	3	2	2
CO3	3	3	3	3	3	3	3	2	2
CO4	3	3	2	3	3	2	3	3	3
CO5	3	2	2	2	2	2	2	2	2
CO6	3	3	3	3	2	2	2	2	2

Industry Consultation Committee:

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Coordinator, Head of Department
Curriculum Development, Department of Mechanical Engineering
Department of Mechanical Engineering

I/C, Curriculum Development Cell Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME 19305				Course Title: CNC Machines & Automation						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2Hrs 30 min)	TS1 (1Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**--**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at midterm and second skill test at the end of the term.

Rational:

In Recent years, the manufacturing environment has undergone dramatic changes. For achieving market of goals, it is essential to produce quality parts in less time. Intervention of information technology in manufacturing has great impact on manufacturing techniques. The strategic requirements such as minimum lead time and high quality cannot be met without the adaption of computerized numerical control (CNC) technology. CNC machines normally are not limited to machine tools only but realm of CNC has widened in almost all areas of manufacturing processes and support activities. It is therefore very important for Mechanical diploma engineer's to master CNC technology.

In this course learner can develop skills required for programming, selection of tooling etc for CNC machine.

Course Outcomes: At the end of the course student will be able to:

CO1	Identity different axes, machine zero, home position, systems and controls CNC machines
CO2	Select, mount and set cutting tools and tool holders on CNC.
CO3	Prepare part programming using ISO format for given simple components with and without use of MACRO, CANNED CYCLE and SUBROUTINE using ISO format.
CO4	Describe working principle Automatic Tool Changing device
CO5	Apply maintenance practices for CNC machines.
CO 6	Describe the different components of automated system.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to CNC Machines** 1.1 Classification of CNC machines 1.2 Important terms related to CNC machining 1.3 Calibration of CNC machines 1.4 Axis standards and its identification 1.5 Drives used in CNC system 1.6 Construction and working of CNC Machines 1.7 Feedback, measurement & correction System **Course Outcome:CO1 Teaching Hours:06 Marks: 08 (R-4, U-4, A-0)**
2	**Constructional features and working of CNC Machines** 2.1 Bed and machine frame construction 2.2 Spindle constructional details 2.3 Constructional details and working of ball screw and L. M .guide ways 2.4 Various spindle drives used in CNC machines 2.5 working of machine control unit 2.6 Types of lubrication system **2.7** working of swarf removal arrangement **2.8** Working of hydraulic and pneumatic systems used for Chuck, tool and pallet changing in CNC machines. **Course Outcome: CO 2 Teaching Hours: 08 Marks:14 (R-4, U-6, A-4)**
3	**CNC Part Programming** 3.1 NC words , G codes M codes 3.2 Programming format, word statement, block format 3.3 Tool offset and tool wears compensation 3.4 Part programming containing subroutines, Do-loops and canned cycle 3.5 Introduction to Macro Programming **Course Outcome: CO3 Teaching Hours: 10 Marks: 12 (R-2, U-4, A-6)**
4	**Tooling for CNC machines** **4.1** Introduction **4.2** Types of CNC Cutting tools **4.3** Types of indexable inserts with it geometry **4.4** Construction of tool holding assembly **4.5** Tool presetting procedure **4.6** Working of Automatic Tool Changing (ATC) device and types of tool magazine **4.7** Safety procedure, alarms, fool-proof procedures **4.8** Online measurement of dimensions, cutting forces, Adaptive controls, communication with servers **4.9** Fixtures used in CNC machines. **Course Outcome:CO4 Teaching Hours: 08 Marks:12 (R-2, U-4, A-6)**

Unit No	Topics / Sub-topics
5	**Common Problems in CNC Machines** 5.1 Common problems In mechanical, electrical, pneumatic, electronic and PC components of NC machines **5.2** Diagnostic study of common problems and remedies **5.3** Use of on-time fault finding diagnosis tools in CNC machines. **Course Outcome: CO5 Teaching Hours:08 Marks:06(R-2, U-0,A-4)**
6	**Industrial Automation** 6.1 Meaning of Automation 6.2 Need of Automation 6.3 Types of Automation 6.4 Advantages and Disadvantages of Automation 6.5 Components of Automated system 6.6 Introduction to Plant Automation & Introduction to Industry 4.0 **Course Outcome: CO6 Teaching Hours:08 Marks:06 (R-2, U-2, A-4)**

Suggested Specifications Table (Theory):
Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to CNC machines	4	4	-	8
2	Constructional features and working of CNC machines	4	6	4	14
3	CNC part programming	2	4	6	12
4	Tooling for CNC machines	2	4	6	12
5	Common Problems in CNC machines	2	-	4	6
6	Industrial Automation	2	2	4	8
	Total	16	20	24	60

List of Experiments: Minimum 10 experiments out of 12 experiments

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Study the constructional details of CNC lathe	2
2	1	CO1	Study the constructional details of CNC milling machine	2
3	2	CO2	Study the constructional details and working of- i) Automatic tool changer and tool setter ii) Multiple pallets iii) Swarf removal iv) Safety Devices	2

Sr. No.	Unit No	COs	Title of the Experiments	Hours
4	2	CO2	Use of software for turning operations on CNC turning center	2
5	2	CO2	Use of software for milling operations on milling center	2
6	3	CO3	Develop a part programme for following lathe operations and make the job on CNC lathe- i) Plain turning & facing operation ii) Taper turning operations iii) Thread cutting operations iv) Operation along contour using circular interpolation.	4
7	3	CO3	Develop a part programme for following milling operations and make the job on CNC milling machine- i) Plain milling ii) Slot milling iii) Pocket milling	4
8	3	CO3	Preparation of work instructions for machine operator while working on CNC machine	2
9	4	CO4	Study of CNC Cutting tools & Tool presetting procedure	2
10	5	CO5	Preparation of preventive maintenance schedule for CNC machines	4
11	6	CO6	Demonstration through Industrial visit for awareness of Industrial Automation.	2
12	2	CO2	Visit to **CNC** machine (production) shop to observe construction and working of CNC machining center/ CNC machines. Write visit report.	2
		Total		**30**

References/ Books

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Mechatronics & Machine Tools	HMT, Bangalore, McGraw-Hill, International Ed, 1998	978-0071-3463-44
2	CNC Machines	Pabla B.S.& M. .Adithan, New age International Ltd. 4th Ed, 2018	978-8122-4342-62
3	CAD/CAM (Computer Added Design & Manufacturing)	Groover, Zimmer, Pearson Education India, 1st Ed, 2006	978-8177-5841-65
5	CAD/CAM/CAE	Chougule N.K., SciTech publication Pvt Ltd. 1st Ed, 2010	978-8183-7117-53
6	CNC Programming Made Easy	Binit Kumar Jha, Vikas Publication House Pvt.l Ld. New Delhi, Revised edition, 2010.	978-8125-9118-07

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- https://youth.be/il28Fz69E80

CO Vs PO and CO Vs PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	1	3	1	2	2	2	3
CO2	3	2	2	3	1	2	3	2	3
CO3	2	3	2	2	1	2	3	1	3
CO4	2	3	2	3	1	2	3	2	3
CO5	2	1	1	3	1	2	2	2	3
CO6	3	2	2	3	1	2	3	2	3

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Coordinator,
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Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19302				Course Title: Industrial Hydraulics and Pneumatics						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**--**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Hydraulic and pneumatic operated machines and equipment are widely used in various industries due to its versatility adaptability to automation. Mechanical engineering technologist are required to maintain such systems in different segments of industries. This competency needs the knowledge of construction and working of different components of hydraulic and pneumatic systems.

This course will give the students the basic skills and knowledge to use and maintain different types hydraulic systems and pneumatic systems.

Course Outcomes: Student should be able to

CO1	Identify various components of hydraulic and pneumatic systems.
CO2	Select pump and other accessories for oil operated system.
CO3	Select control valves and actuators for given fluid operated system.
CO4	Select compressor and other component for air operated system.
CO5	Develop different hydraulic circuits for given application
CO6	Develop different pneumatic circuits for given application

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Hydraulic and Pneumatic systems** **1.1.** General layout of Oil Hydraulic system. **1.2.** Practical applications of Hydraulic system. **1.3.** Merits and limitations of Hydraulic system. **1.4.** ISO symbols used in Hydraulic system. **1.5.** General layout of Pneumatic system. **1.6.** Practical applications of Pneumatic system. **1.7.** Merits and limitations of Pneumatic system. **1.8.** ISO symbols used in Pneumatic system. **Course Outcome: CO1 Teaching Hrs:04 Marks: 08 (R-2, U-4, A-2)**

2	**Pumps and Accessories in Hydraulic system** **2.1.** Pump: Classification of Pump, Construction and working of Gear pump, Vane pump, Screw pump, Piston pump **2.2.** Accessories: Oil reservoir, pipes, hoses, fittings, oil filters, seals and gaskets, accumulators, heat exchangers **2.3.** Types of hydraulic oils used in hydraulic systems and their specifications **Course Outcome: CO2 Teaching Hrs:06 Marks: 10 (R-4, U-4, A-2)**
3	**Control Valves and Actuators** **3.1.** Classification of Control Valves **3.2.** Pressure Control Valves: Construction and working of Pressure relief valve, Pressure reducing valve, Unloading valve. **3.3.** Direction Control Valve: Check valve, 2/2, 3/2, 4/2, 4/3, 5/2, 5/3 DC valve used in Hydraulics and Pneumatics system. **3.4.** Flow Control Valves: Variable flow control valve Pressure compensated, Non compensated flow control valve, **3.5.** Classification of Hydraulic and Pneumatic actuators, Construction and working of Linear and Rotary actuators **Course Outcome: CO3 Teaching Hrs:10 Marks: 10 (R-4, U-4, A-2)**
4	**Compressor and Pneumatic Components** **4.1.** Types, Construction, working principle of Reciprocating and Rotary compressor **4.2.** Construction, working principle of FRL unit, Dual (Twin) pressure valve, Shuttle valve, Quick exhaust valve, Time delay valve **Course Outcome: CO4 Teaching Hrs: 08 Marks:10 (R-4, U-4, A-2)**
5	**Oil Hydraulic Circuits** **5.1.** Simple oil Hydraulic circuits- Single and Double acting hydraulic cylinders, motors **5.2.** Speed control- Meter in, Meter out, Bleed off circuit. **5.3.** Regenerative, Synchronizing, Sequencing circuits. **5.4.** Hydraulic circuit for Milling machine, Shaper machine, Grinding machine **5.5.** Remedies and fault detection in Hydraulic circuits **Course Outcome: CO5 Teaching Hrs: 09 Marks: 12 (R-2, U-4, A-6)**
6	**Pneumatic Circuits** **6.1.** Direct and indirect control of Single Acting and Double Acting air cylinders, Motors **6.2.** Speed control circuit for cylinders and motors **6.3.** Sequencing circuits **6.4.** Remedies and fault detection in Pneumatic circuits **Course Outcome: CO6 Teaching Hrs: 08 Marks: 10 (R-2, U-2, A-6)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Hydraulic and Pneumatic systems	02	04	02	08
2	Pumps and Accessories in Hydraulic system	04	04	02	10
3	Control Valves and Actuators	04	04	02	10
4	Compressor and Pneumatic Components	04	04	02	10
5	Oil Hydraulic Circuits	02	04	06	12
6	Pneumatic Circuits	02	02	06	10
	Total	**18**	**22**	**20**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Identify components of Hydraulic system.	02
2	1	CO1	Identify components of Pneumatic system.	02
3	1	CO1	List and draw symbols used in hydraulic system.	02
4	1	CO1	List and draw symbols used in pneumatic system.	02
5	2	CO2	Use Pump and other components mounted on hydraulic trainer kit	02
6	3	CO3	Use of control valve and actuators in hydraulics and pneumatics	02
7	4	CO4	Use of compressors, FRL unit and accessories in pneumatics	02
8	5	CO5	Assemble & actuate meter in, meter out hydraulic circuit	04
9	5	CO5	Develop circuit for simple machine tool application such as milling machine, shaper machine, grinding machine	02
10	5	CO5	Assemble & actuate sequencing hydraulic circuit	04
11	6	CO6	Construct and actuate speed control pneumatic circuits	02
12	6	CO6	Develop any suitable pneumatic sequencing circuit	04
Total				**30**

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	Oil Hydraulic system-principles and maintenance	Majumdar S.R. McGraw Hill, New Delhi, 7th Ed; 2002	978-0071-4066-97
2	Pneumatic Systems principles and maintenance	S.R. Mujumdar, Tata McGraw Hill Publishing Company Ltd, 1st Ed., 1995	978-0074-6023-17
3	Fluid Power with applications	Esposito, Anthony, Pearson Education Inc, New Delhi , 7th Ed., 2008	978-0135-1369-04
4	Hydraulics and Pneumatics	Stewart, Harry, Taraporewala Publication, 1st Ed., 1984	978-0672-2341-25
5	Pneumatic Controls	Joji B, Wiley India Publication, New Delhi, 1st Ed., 2008	978-8126-5154-24
6	Hydraulics and Pneumatics A Technicians and Engineers Guide	Parr, Andrew Butterworth-Heinemann Publisher, 3rd Ed.,2011	978-0080-9667-48
7	Industrial Hydraulics Manual	Vickers Systems International, Eaton Hydraulics, (Training Manual) 2nd Ed; 2006	978-0963-4162-09

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2. Hydraulic Pumps: www.hydraulicspneumatics.com/...HydraulicPumpsM/.../TechZOne-HydraulicPumps.
3. Animation of Hydraulic pumps: https://www.youtube.com/watch?v=Qy1iV6EzNHg
4. Animation of Hydraulic pumps: https://www.youtube.com/watch?v=pWuxYnqYDnk
5. Pneumatic control valves animation: https://www.youtube.com/watch?v=XAItnsUcES0
6. Control valve symbol generation: https://www.youtube.com/watch?v=yIot4shcOkE
7. Animation of DC valve: https://www.youtube.com/watch?v=jsMJbJQkGTs
8. Animation of 4/2, 4/3 DC valve: https://www.youtube.com/watch?v=CQPwvWXbV3w
9. Animation of Hydraulic cylinder: https://www.youtube.com/watch?v=bovfDsAYSbc
10. Pneumatic cylinder: https://www.youtube.com/watch?v=MmYpzgh6Gok
11. Speed control hydraulic circuit: https://www.youtube.com/watch?v=4eCuPVxezzY
12. Telescopic cylinder animation: https://www.youtube.com/watch?v=icaqvfAtccY

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	1	2	1	2	1	3	2	1
CO2	2	3	3	2	2	2	3	3	2
CO3	3	3	3	3	2	2	3	3	2
CO4	3	3	3	3	2	2	3	3	2
CO5	3	3	3	2	3	2	3	3	3
CO6	3	3	3	2	3	2	3	3	3

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Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19311				Course Title: Design of Machine Elements						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (3 Hrs 30 min)	TS1 (1 Hr 30 min)	TS2 (1Hr 30 min)	PR	OR	TW	Total
3	**2**	**--**	**5**	**60**	**20**	**20**	**--**	**--**	**25**	**125**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Design of Machine Elements is an applied technology subject. This course needs essential fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials, Machine Drawing and Theory of Machines. A diploma holder in mechanical discipline is expected to design and draw simple machine components used in industries.

This course aims for developing analytical abilities to give solutions to engineering design problems.

Course Outcomes: Student should be able to-

CO1	Define basic concepts in design, Factor of safety and Theories of failures.
CO2	Prepare design for eccentric loading, joints, levers and offset links
CO3	Design keys, shafts and couplings
CO4	Design of bolts for brackets and welded joints
CO5	Design power screws
CO6	Design of helical springs.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction to Design of Machine Elements** **1.1. Basic Design Considerations:** Design philosophy and Procedures, General Considerations in design, Types of loads, concepts of stress ,strain, Stress – Strain Diagram for Ductile and Brittle Materials, True Stress-Strain and Engineering stress strain diagram , Types of Stresses such as Tension, Compression, Shear, Bending, Crushing and Bearing pressure, Concept of Creep, Fatigue, S-N curve, Endurance Limit **1.2. Factors of Safety and Material Designation:** Factor of Safety and Factors affecting its selection, Stress Concentration – Causes & Remedies, Converting actual load or torque into design load/torque using design factors, Designation of materials as per IS and

Unit No	Topics / Sub-topics
	introduction to International standards, advantages of standardization, use of design data book and use of standards in design **1.3. Variable stresses:** Fluctuating stresses, fatigue, fatigue failure,, S-N curve, Endurance limit, stress concentration and its remedies **1.4. Theories of Elastic Failures:** Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory **1.5.** Modern design considerations, Ergonomic and Aesthetic consideration and concept of product design **Course Outcome: CO1 Teaching Hours: 08 Marks: 10 (R-2, U-4, A-4)**
2	**Design of Joints and Offset links** **2.1.** Design of Cotter Joint, Knuckle Joint and Design of bell crank lever **2.2.** Design of Off-set links, C – Clamp, Overhang Crank **Course Outcome: CO2 Teaching Hours:07 Marks: 10 (R-0, U-4, A-6)**
3	**Design of Shafts, Keys and Couplings** **3.1. Design of Keys and Shaft:** Design of Rectangular, parallel sunk keys, Effect of Keyways on strength of shaft. Types of Shafts, Shaft materials, Standard Sizes, Design of shafts (Hollow and Solid) using strength and rigidity criteria, ASME code of design for line shafts supported between bearings with one or two pulleys in between or one overhung pulley. **3.2. Design of Couplings:** Protected type Flanged coupling and Bush-pin type flexible coupling. **Course Outcome: CO3 Teaching Hours: 08 Marks: 10 (R-4, U-0, A-6)**
4	**Design of threaded and welded joints** **4.1.** Stresses in Screwed fasteners, bolts of Uniform Strength. **4.2.** Design of Bolted Joints for brackets when the load is parallel and perpendicular to the axis of the bolt considering axial and eccentric loading **4.3.** Design of parallel and transverse fillet welds, axially loaded symmetrical sections. ASME codes for welded joints **Course Outcome: CO4 Teaching Hours: 07 Marks: 10 (R-2, U-4, A-4)**
5	**Design of Power Screws** **5.1. Basic concepts:** Thread Profiles used for power Screws, relative merits and demerits of each, Self-locking and overhauling property, Torque required to overcome thread friction, efficiency of power screws, types of stresses induced. **5.2.** Design of Screw Jack. **Course Outcome: CO5 Teaching Hours: 07 Marks: 10 (R-4, U-0, A-6)**
6	**Design of springs** **6.1.** Classification and Applications of Springs, Spring - terminology, materials specifications. Stresses in springs, Wahl's correction factor, Deflection of springs, Energy stored in springs, construction and application of Leaf spring.

Unit No	Topics / Sub-topics
	6.2. Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers and governor springs. **6.3.** Design of leaf spring without considering prestressing for the leaves **Course Outcome: CO6 Teaching Hours: 08 Marks: 10 (R-4, U-0, A-6)**

Suggested Specifications Table (Theory):

Level of questions: R: Remember, U: Understand, A: Apply

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Design	02	04	04	10
2	Design of Joints, Levers and Offset links	--	04	06	10
3	Design of Shafts, Keys and Couplings	04	--	06	10
4	Design of threaded, welded joints and Introduction to Bearings	02	04	04	10
5	Design of Power Screws	04	--	06	10
6	Design of Springs	04	--	06	10
	Total	**16**	**12**	**32**	**60**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
1	1	CO1	Assignment based on Fundamental Design Concepts	02
2	2	CO2	**Design of Knuckle/Cotter Joint/ Levers:** Observe the system where transmission of reciprocating forces or static compression/tensile load takes place through the links of a mechanism. Get the required information regarding load transmitted. By selecting suitable materials from design data book, design the Knuckle/ Cotter/Turn Buckle/Levers. Prepare design report, details and assembly drawing indicating overall dimensions, tolerances, fits and surface finish. Also prepare bill of materials. (Activity should be completed in a group of maximum four students)	06
3	3	CO3	**Design of Protected Type Rigid Flange/ Bushed Pin Type Flexible Coupling:** Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motor or engine etc.). By selecting suitable materials from design data book, design the coupling. Prepare design report, details and assembly drawing indicating overall dimensions, tolerances, fits and surface finish. Also prepare bill of materials. (Activity should be completed in a group of maximum four students)	06
4	3	CO3	**Design of Stepped Solid/Hollow Shaft:** Observe the system where transmission of power takes place through shaft, Keys, coupling, pulley and belt drive. Get the required information regarding power transmitted (power output by motor or engine etc.). By selecting suitable materials	04

Sr. No.	Unit No	COs	Title of the Experiments	Hours
			from design data book, design the Stepped solid/hollow shaft subjected to combined bending and torsional stresses. Prepare design report, indicating overall dimensions, tolerances, fits and surface finish. (Activity should be completed in a group of maximum four students)	
5	5	CO5	**Design of Screw Jack:** Observe the System where transmission of power takes place through power Screws. (e.g. Lead screw of lathe, feed screws of machine tools, Clamping screws, Screw Jack.). Get the required information regarding effort, clamping force, etc., and selecting suitable materials from data book design screw, nut and different simple components in assembly. Prepare design report, details and assembly drawing indicating overall dimensions, tolerances, fits and surface finish. Also prepare bill of materials. (Activity should be completed in a group of maximum four students)	06
6	2/5	CO2 CO5	Prepare CAD Drawing for Practical No 2 or 5 in practical and print out of sheet should be attached.	02
7	4	CO4	Assignment based on design of welded joints and bolts.	02
8	6	CO6	Assignment on design of helical springs	02
Total				**30**

Note: All the design sheets and assignments are compulsory.

References/ Books:

Sr. No.	Title	Author, Publisher, Edition and Year Of publication	ISBN
1	A Text book of Machine Design	R S. Khurmi and J. K Gupta., S. Chand Publication, 34th edition, 1979	978-8121-9253-72
2	Design of Machine Elements	V B. Bhandari, Tata Mc-Graw Hill Publication, 4th Edition, 2016	978-9339-2211-26
3	Schaum's Outline of Machine Design	Alfred S. Hall, A. R. Holowenko, H. G. Laughlin, Tata Mc-Graw Hill Publication, 1st Edition, 2007	978-0070-6345-89
4	Machine Design Data Book	V B Bhandari, Tata Mc-Graw Hill Publication, 2nd Ed; 2019	978-9353-1663-04
5	Handbook of Mechanical Design	Gitin M. Maitra, L. V. Prasad, Tata Mc-Graw Hill Publication, Ed, 2001	978-0074-6023-86
6	Shigley's Mechanical Engineering Design	Richard G. Budynas, Keith J. Nisbett, Tata Mc-Graw Hill Publication, 11th Ed, 2020	978-0073-3982-11
7	Machine Component Design	Robert C.Juvinall, Wiley India Edition	978-8126-5597-32
8	Design Data: Data Book of Engineers	Compiled by: Faculty of Mechanical Engineering, 8th , Published by: Kalaikathir Achachgam, Coimbatoree	PSG College Technology Coimbatore

IS Codes

a) IS 4218: 1967 ISO Metric Threads
b) IS 2693: 1964 Cast Iron Flexible Couplings
c) IS 2292: 1963 Taper keys & Keyways
d) IS 2293: 1963 Gib Head Keys & Keyways
e) IS 2389: 1963 Bolts, Screws, Nuts & Lock Nuts
f) IS 4694: 1968 Square threads
g) IS 808: 1967 Structural Steel

E-References:

1. https://ndl.iitkgp.ac.in/
2. https://www.slideshare.net/anjanpatel1/design-of-springs
3. https://www.pdfdrive.com/search?q=machine+design+theory&pagecount=&pubyear=&searchin

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	2	2	2	2	2	2	3	2	2
CO2	2	3	3	2	2	2	3	3	2
CO3	3	3	3	2	2	2	3	3	2
CO4	**3**	3	3	2	2	2	3	3	2
CO5	3	3	3	2	2	2	3	3	2
CO6	3	3	3	2	2	2	3	3	2

Industry Consultation Committee:

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Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19303				**Course Title: Solid Modeling**						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4**	**--**	**4**	**--**	**--**	**--**	**25***	**--**	**25**	**50**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination.

Note: For Minimum passing marks under various heads, refer, examination rule AR 26. Two practical skill test are to be conducted. First skill test at mid term and second skill test at the end of the term

Rationale:

Manufacturing industries have to design, develop, and manufacture the products in minimum possible time, at economical rate, and mainly without negotiating on the quality aspects, to sustain in competitive market. Hence, design and production department has to work together in an integrated approach. An application of computer in design, development, and manufacturing has created the way for highly flexible, accurate and fast integrated approach in manufacturing the parts. The process begins with conceptualizing the machine components and assemblies in automobiles, machine tools, and earth movers etc. as 3D models, making application of solid modeling software as a need of time in industries. In this context, the mechanical engineering diploma student must be well conversant with use of different features of solid modeling software. Students are also required to know the fundamentals of computer aided manufacturing. This course deals with the concept of solid modeling to enhance the solid modeling skills of the diploma engineering students. This course will enable the students to inculcate solid modeling concepts to solve engineering problems.

Course Outcomes: Student should be able to

CO1	Create and Constraint 2D sketches
CO2	Generate 3D models of machine components
CO3	Prepare assembly of 3D modelled components.
CO4	Create 3D surface models
CO5	Generate orthographic views/ drawings of models / assemblies.
CO6	Simulate tool path and create NC files

Course Content Details:

Unit No	Topics / Sub-topics
1	**Introduction & 2D Sketching** 1.1 Introduction, Need of solid modeling, Different software's for Solid Modeling, Applications, Benefits. 1.2 Getting familiar with User Interface, Navigation tools, Drawing Units 1.3 Print setup, Layout preparation, 1.4 Making basic sketches- rectangle, circle etc., making polygons, circular/rectangular sketch patterns, 1.5 Modifying 2D sketches using trim, extend, offset etc. Geometrical constraints, 1.6 Export the drawing in dxf/ dwg,/ svg,/ pdf formats , and Print /Plot the drawings **Course outcome : CO1**
2	**3D Modeling** 2.1 3D modeling using extrude, revolve, sweep, etc. 2.2 Modifying 3D models by fillet, chamfer, use of rectangular and circular patterns, move, copy etc. Boolean operation : union, subtract, intersection 2.3 Making construction /reference planes 2.4 Modeling of simple machine components, such as spur gear, 3D spanner, nut bolts, pipe Joints, bearings, couplings, brackets, tools etc. 2.5 Export model in IGES/ STEP/ STL/dxf/ dwg,/ svg,/ pdf formats, and Print /Plot the 3D models **Course outcome : CO2**
3	**Assembly Modeling** 3.1 3D Modeling of assembly components (Assembly should have minimum three components like screw jack, bearings, tails stock, pipe vice, tool holders, couplings, pipe joints etc.) 3.2 Joints/constraints in Assembly, 3.2 Assembly motion, 3.3 Exploded view of assembly 3.3 Export assembly in IGES/ STEP/ STL/dxf/ dwg,/ svg,/ pdf formats & Print /Plot the Assembly **Course outcome : CO3**
4	**Surface Modeling** 4.1 Introduction, Creating free form surfaces 4.2 Creating free form surface models like water bottle, flower pot, heating iron, detergent bottle, soap case etc. 4.3 Export model IGES/ STEP/ STL/dxf/ dwg,/ svg,/ pdf formats, and Print /Plot the surface model. **Course outcome : CO4**
5	**Drafting** 6.1 Generate 2D drawings from 3D models 6.2 Insert base view, projected views - front view, top view, side view, sectional views, isometric views, etc. 6.3 Drafting of Assemblies 6.4 Dimensioning, 6.5 Bill of material for assemblies

	6.6 Export drawing in IGES/ STEP/ STL/dxf/ dwg,/ svg,/ pdf formats, and Print /Plot the drawing of model/ assemblies **Course outcome : CO5**
6	**Introduction to CAM** 7.1 Setup, Tool Manager, Drilling tool path, 2D tool path, simulate, setup sheets, post NC files 7.2 3D Printing, export to STL 7.3 Print /Plot the tool path and NC files **Course outcome : CO6**

List of experiments:

Sr. No.	Unit No	COs	Title of the Experiments	Hours
			Lab Orientation & Safety Instructions	02
1	1	CO1	Introduction to Graphics User Interface, Demonstrate the use of navigating tools, sketching of 2D sketches and constraints. **Prepare minimum four 2D sketches and printing/ plotting the drawings.**	08
2	2	CO2	Demonstrate to prepare 3D models from 2D sketches involving use of extrude, revolve, sweep, etc. commands, and modify commands. **Prepare minimum four 3D Models of machine components and printing / plotting the models.**	10
3	3	CO3	Demonstration of assembling the 3D models, establishing the motion in components of assembly. **Prepare an assembly from 3D modelled components, establish motion in assembly components, and printing/plotting an assembly.**	06
4	3	CO3	Demonstration of creating exploded view of an assembly. **Prepare exploded view of an assembly from prepared assembly and printing/plotting exploded view of an assembly.**	04
5	4	CO4	Demonstration of creating free form surfaces such as water bottle, flower pot, heating iron, detergent bottle, soap case, table lamp etc. **Prepare minimum four freeform surface models and printing / plotting the surface model.**	08
6	5	CO5	Demonstration of creating drafting i.e. base view, projected views, sectional views, isometric views of models. **Prepare the drafting of minimum four 3D models and printing / plotting the different views of 3D model.**	04

Sr. No.	Unit No	COs	Title of the Experiments	Hours
7	5	CO5	Demonstration of creating drafting i.e. base view, projected views, sectional views, isometric views of assembly, and bill of materials. **Prepare the drafting of minimum one assembly, bill of material (BoM), and printing / plotting the different views of assembly.**	06
8	6	Co6	Demonstration for Computer Aided Manufacturing for machining of the given component. **Select the tool, and simulate tool path for machining of the modelled component, and print / plot the tool path.**	08
9	6	CO6	Demonstration for Computer Aided Manufacturing for machining of the given component. **Generate the G codes for machining of the given component and print / plot the codes.**	04
Total				**60**

References/ Books:

1. User guides/ manual of Fusion 360 software

E-References:

1. https://thesourcecad.com/fusion-360-tutorial/
2. https://academy.autodesk.com/node/125076/take?q-nr=4

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	2	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	2
CO4	3	3	2	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3
CO6	3	3	2	3	2	3	3	3	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Amit Gunjal	CEO	Milestone PLM Solutions, Thane
2	Mrs. Sameera Dhanawade Rawle	Managing Director	United Technologies, Virar
3	Dr. Shirish Dhobe	Lecturer in Mech. Engg.	Government Polytechnic, Thane
4	Dr. Sandeep Anasane	Associate Professor	College of Engineering, Pune
5	Shri. U.A. Agnihotri (Curriculum Content Designer)	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
6	Dr. V. U. Rathod (Curriculum Content Designer)	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

Programme: **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code: ME19308				Course Title: Project						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30 min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**4**	**--**	**4**	**--**	**--**	**--**	**--**	**50***	**50**	**100**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination
Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill test are to be conducted. First skill test at midterm and second skill test at the end of the term

Rationale:

Diploma technicians is expected to integrate and apply the theory and practical skills to solve the industrial issues. This requires the abilities for problem identification, definition and problem analysis, development of alternatives and implementation of solution. The comprehensive understanding of various courses studied and application of basics to derive solution need to be developed within technicians.
This course provides the opportunity for learners to solve the problem, using technical knowledge and skills gained during previous semesters. It also simulates the situation for team working, leading and self-motivation through work.

Course Outcomes: Student should be able to

CO1	Identify, Analyze and Define the problems.
CO2	Derive solutions to the problem and select most appropriate solution.
CO3	Use various information resources to collect information related to project idea.
CO4	Manage conflicts and work effectively in team.
CO5	Design, Develop, and Manufacture the machine/equipment.
CO6	Prepare project related documentation, communicate and present work done.

Course Content Details:

Unit No	Topics / Sub-topics
1	**Methodology:** **1.** This course will be completed in the fifth semester. **2.** Course registration will be at the beginning of the fifth semester. **3.** A batch will be formed of maximum four students. **4.** A project dairy is to be maintained by each student giving details of planning, work executed, information collected etc. on weekly basis and the same should be shown to the guide concerned. **5.** Project report should be of about 50 to 70 pages of Times New Roman font. Font size of main heading, subheading and text should be 16, 14, 12 respectively. The report should consist of text, drawing, graphs, tables, photographs etc. of about 5000 words

	6. Batch formation, project identification, project selection, survey work, production of model, if any presentation should be completed during the fifth semester.
2	**Following is the suggestive list of topics for selection of project:** **1.** A fabrication of small machine / test rig/ devices etc. **2.** Design and fabrication of mechanisms, machine and devices etc. **3.** Development of computer programming. **4.** Industry supported project. **5.** Literary based survey project. **6.** Investigative type project. **7.** Maintenance based project **8.** Industrial Engineering-based project **9.** Low cost automation project **10.** Creativity based engineering project **11.** Environment based project **12.** Market survey project **13.** Project in recent trends in mechanical engineering **14.** Appropriated technology related to rural areas
3	**Project Report preparation:** Suggested contents of the Project Report (Guide can make required changes as per nature of project) • Title page (with name of team members and mentor teacher) • Certificate • Acknowledgments • Abstract • Content page **1.** Chapter -1 Introduction & Project Definition **2.** Chapter-2 Literature survey **3.** Chapter-3 Project Planning **4.** Chapter-3 Design & Solid Modelling **5.** Chapter-4 Fabrication/ Manufacturing **6.** Chapter-5, Trials & Experimentation **7.** Chapter-6 Costing **8.** Chapter-7 conclusion and future scope **9.** Appendix (if any) **10.** References and Bibliography

Rubric 1: For Project Oral

Criterion No	Criterion	CO	Max Marks	Not Satisfactory (1-4)	Satisfactory (5-6)	Good (7-8)	Excellent (9-10)
1	Literature survey	CO1 CO2 CO3	10	Information is gathered from a single source.	Information is gathered from a limited number of sources.	Information is gathered from multiple sources.	Information is gathered from multiple, research-based sources.
2	Organization of presentation	CO2	10	Audience cannot understand presentation because there is no sequence of information	Audience has difficulty following presentation because student jumps around.	Student presents information in logical sequence which audience can follow	Student presents information in logical, interesting sequence which audience can follow.
3	Graphics (use of PowerPoint)	CO4	10	Uses graphics that rarely support text and presentation	Uses graphics that relate to text and presentation	Uses graphics that explain text and presentation	Uses graphics that explain and reinforce text and presentation
4	Elocution and eye contact	CO2 CO4	10	Mumbles and/or Incorrectly pronounces some terms/ Voice is low; difficult to hear	Voice fluctuates from low to clear; difficult to hear at times	Voice is clear with few fluctuations; audience can hear well most of the time	Voice is clear and steady; audience can hear well at all times
				Reads most slides, no or just occasional eye contact	Refers to slides to make points, occasional eye contact	Refers to slides to make points, eye contact majority of time	Refers to slides to make points, engaged with audience
5	Oral	CO1 CO2 CO3 CO4 CO5 CO6	10	Does not understands question /no answer to question	Answers some questions but not clearly and completely	Answers to most of the questions clearly and completely	Answers to all questions confidently

Rubric 2: For Project TW

Criterion No	Criterion	CO	Max Marks	Not Satisfactory (1-4)	Satisfactory (5-6)	Good (7-8)	Excellent (9-10)
1	Problem Identification	CO1	10	Little or no background information is presented to help the audience understand the history and significance of the project.	Background information is provided, an explanation of why the project was undertaken, to help put the presentation in context.	Background information is provided, including references to the work of others and an explanation of why the project was undertaken, to help put the presentation in context.	Insightful and in-depth background information is provided to illuminate the issues through inclusion of history relevant to the presentation, a succinct description of the significance of the project.
2	Literature Review	CO1 CO2	10	Very few and not relevant	Few and relevant	Relevant information from multiple sources	Information is gathered from multiple, research-based sources.
3	Planning of Project Work And Team Structure	CO3 CO4	10	Time frame not properly specified, In-appropriate distribution of project work	Time frame properly specified, but not being followed, Distribution of project work un-even	Time frame properly specified and being followed Distribution of project work inappropriate	Time frame properly specified and being followed, Appropriate distribution of project work
4	Testing	CO5	10	Testing done not done properly , no correct method of testing	Testing done in single condition , required modification not done after testing	Testing done in multiple condition , required modification not done after testing	Testing demonstrates engineering skill , required modification done after testing
5	Project Report	CO6	10	Project report not prepared according to the specified format, References and citations are not appropriate.	Project report is according to the specified format but some mistakes In-sufficient references and citations	Project report is according to the specified format, References and citations are appropriate but not mentioned well	Project report is according to the specified format References and citations are appropriate and well mentioned

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	2	2	3	3	3
CO2	3	3	3	3	2	3	3	3	3
CO3	3	3	3	2	2	2	3	3	3
CO4	3	3	3	3	2	2	3	2	3
CO5	3	3	3	3	2	3	3	3	3
CO6	3	3	2	2	2	2	3	3	2

Industry Consultation Committee:

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5	Mr. K. Z. Dhangare	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
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Coordinator,
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Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

P19 Curriculum

Sixth Semester

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19)

With effect from AY 2019-20

Programme: Diploma in Mechanical Engineering (Sandwich Pattern) **Term / Semester -VI**

Course Code	Course Title	Teaching Hours/Contact Hours				Credits	Examination Scheme (Marks)						
							Theory			PR	OR	TW	Total
		L	P	TU	Total		TH	TS1	TS2				
ME19313	INPLANT TRAINING	--	40	--	40	20	--	--	--	--	100*	100*	**200**
	Total	**--**	**40**	**--**	**40**	**20**	**--**	**--**	**--**	**--**	**100**	**100**	**200**
Total Contact Hours					**40**								

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment)

***** Indicates assessment by External Examiner else internal practical skill test, #indicates self, on- line learning Mode, **@** indicates on line examination

Note: Duration of Examination--TS1&TS2 -1 hour, TH- 2 hours 30 min, PR/OR – 3 hours per batch, SCA- Library -1 hour, Sports- 2hours, Creative Activity-2 hours

# indicates Self, on- line learning Mode through MOOCs/Spoken Tutorials /NPTEL/SWAYAM/FOSSEE etc.

Department Coordinator,
Curriculum Development,
Dept. of Mechanical Engineering

Head of Department
Dept. of Mechanical Engineering

In-Charge
Curriculum Development Cell

Principal

Programme : **Diploma in Mechanical Engineering (Sandwich Pattern)**										
Course Code:ME19313				Course Title: INPLANT TRAINING						
Compulsory / Optional: Compulsory										
Teaching Scheme and Credits				Examination Scheme						
L	P	TU	Total	TH (2 Hrs 30min)	TS1 (1 Hr)	TS2 (1Hr)	PR	OR	TW	Total
--	**40**	**--**	**20**	**--**	**--**	**--**	**--**	**100***	**100***	**200**

Abbreviations: L- Theory Lecture, P-Practical, TU-Tutorial, TH- Theory Paper TS1 & TS2- Term Tests, PR-Practical, OR-Oral, TW: Term Work (progressive assessment) , * Indicates assessment by External Examiner else internal practical skill test , # indicates Self, on- line learning Mode, @ indicates on line examination

Note: For Minimum passing marks under various heads, refer, examination rule AR26. Two practical skill tests are to be conducted. First skill test at mid-term and second skill test at the end of the term.

Rationale:

There will always be the need of talented, innovative, and skilled manpower for industries to sustain in competitive market. Industries adopt different policies to get the employable manpower as per the demand. In-plant training, internship, apprenticeship etc. are some of the useful strategies for generating future talent pool for the industry. These programs not only helps fresh pass outs in gaining professional knowhow but also benefits, industries on fresh perspectives on business issues and even discovering future business leaders. Students passing out from technical institutions lack the experience, skills and confidence required by industries. In present scenario competition for job is rising exponentially and securing entry-level jobs is getting very difficult. Hence organizations like AICTE, BOAT, NATS, MEMS, State Boards of Technical education etc. are promoting industrial internship/industrial training at different level in technical institutes.

The main aim of In-plant training is to increase the employability skills of the students passing out from institute. For getting real time exposure of industrial environment six- month in-plant training is incorporated in the curriculum of Mechanical Engineering Department. The outcomes of the training will definitely a step ahead in making students employment-ready and will augment various attributes in students.

Course Outcomes: Student should be able to

CO1	Realize administrative, operational and social functioning of industrial organizations.
CO2	Follow industrial working practices, industrial safety practices, and industrial discipline.
CO3	Correlate the theory with industrial applications relevant to the courses studied.
CO4	Select various materials, processes, tools, products etc. with their relevant aspects of manufacturing, quality control, etc.
CO5	Recognize responsibilities, ethical values, required interpersonal skills, problem solving skills, self-management and job management skills required while working as first line manager.
CO6	Effectively communicate through technical reports/projects report writing, presentation skills.

Course Content Details:

Unit No	Topics / Sub-topics
1	Mechanical Engineering students study various courses that enable them to work in number of fields related to mechanical engineering namely but not limited to design, thermal engineering, management and industrial engineering, mechatronics, production processes, materials engineering, power engineering, fluid mechanics, etc. Student will be placed as a trainee in different industries, organizations etc. for inplant training. During inplant training, students may work as supporting member of project team, assist in production work, small tasks, observe the procedures, collect the information etc. at supervisory level pertaining to the following broad areas: **1. Production systems and processes** • Product development, process planning and selection of equipment • Design and installation of quality engineering and analytical systems • Investigations regarding mechanization, automation and robotics etc. • Computer-supported production systems etc. **2. Industrial Engineering** • Work study, Method study, Time study activities sampling and determination of time standards and labour/machine costs • Development of wage incentive schemes, work performance, • Measures and task/process evaluation systems, determination of human • resource requirements, occupational safety and health, Productivity measurement • Design of plant layout, space saving in shop floor area, installation of new machines, work and material flow, importance of visuals for operations, mock drills for safety, process improvements by kaizen and other techniques, etc. **3. Quality assurance** • Quality assurance techniques, e.g. application of statistical process control techniques, control charts, • Inspection methods, measurement techniques, identification of sampling plans for quality control and metrology • Implementation of quality management systems, standards like ISO 9000, TS16949, OHSAS, etc • Creation of a quality culture and total quality management . • Inspection of incoming and outgoing material of factory including in-process and post-process inspection **4. Production planning and control** • Stock and purchasing management • Design and implementation of production planning- and control systems • Distribution planning, Capacity planning • Material requirements planning, production scheduling • Development and implementation of maintenance planning systems **5. Project management** • Project planning, -organizing and -control • Scheduling and network planning

- Resource allocation , work division
- Design and implementation of management information systems and data warehousing and processing systems

6. Thermal Engineering

- Refrigeration, Air-conditioning, HVAC
- IC engines, power engineering
- Automobile Engineering
- Design of Automobiles
- Design and fabrication of automobile components

8. Hydraulics and Pneumatics

9. Tool Room, CAD/CAM/CAE and Automation etc.

10. Purchase

- Purchase procedures, vendor finalization, costing and estimating, etc.

11. Marketing

- Marketing activities such as advertising by various tools, market research, future product marketing strategies, etc.

12. Maintenance Engineering

- Maintenance procedures of various machines, check list, types of maintenance, TPM activities
- Installation of new machines
- Defining safety procedures of machines, safety trainings, etc.

IMPORTANT GUIDELINES FOR STUDENTS

- Students will be placed in different industries for in-plant training. Student has to complete minimum 20 weeks of training **or** 800 hours (considering 5 days/week x 8 hrs per shift x 20 weeks) of training **or** number of weeks of training as per the norms of the respective industries.
- During In-plant training, student will be assigned to a polytechnic supervisor and industry supervisor. Polytechnic supervisor will visit the industry during training, guide the students, and resolve the issues of students if any. Industry supervisor will be the officer/shop in-charge/work manager etc., under whom student is working in industry daily.
- Student has to maintain in-plant training diary & in-plant training manual regularly.
- Student has to prepare the In-plant training report at the end of training under the supervision of polytechnic supervisor and industry supervisor.
- TW will consist of updated and signed/certified copies of daily in-plant training diary, weekly diary/in-plant training manual, and In-plant training report.
- Participating/completing specific project, mini project, special assignment etc. and including it in in-plant training report will be an added advantage for the students.

	• During In-plant training, students have to follow the rules and regulations of respective industries. Student should not share any information/sketches/calculations/ formulae etc. of company / department to anyone. • Students i.e. in-plant trainees must take oral/written prior permission for any type leave from respective industry supervisors. Without permission students should not remain absent. • Every student will be jointly assessed by polytechnic supervisor, and industry supervisor through mode of Oral examination as well as Term work, after successful completion of training. • No students will be allowed to change the industry on his/her own. • Each student has to abide safety rules of allocated industry. They have to follow safety procedures of industry. **Course Outcome:CO1 to CO6 Total Hours: Min. 20 weeks/800 Hrs**

Documents/Activities to be completed during Inplant Training :

Sr. No.	Unit Mapping	CO Mapping	Title of Activities	Remark
1	-	CO1-CO6	**Daily Diary :** Students will regularly maintain the daily diary noting daily activities completed during training, get it certified from concerned supervisors time to time. **Inplant Training Manual:** Students will carefully read the guidelines of Inplant training manual, follow the instruction given. Trainees will regularly maintain inplant training manual updated noting activities completed weekly during training, get it certified from concerned supervisors time to time. **Inplant Training Report:** At the end of the training, trainee will prepare inplant training report, detailing introduction of industry, products, activities performed/observed, assignments /projects participated/ completed, Skills achieved, and conclusions.	
			Total Hrs	**20 weeks /800hrs**

References/ Books: Inplant Training manual

CO Vs PO and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3
CO6	3	3	3	3	2	2	3	3	3

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mrs. Pooja Acharekar	Manager, HR	L&T, Powai
2	Mr. Mangesh Nagle,	Managing Director	Pragati Switchgears, Vasai
3	Mr.G.J. Badwe	Lecturer in Mech. Engg, Training Placement Officer.	SBM Polytechnic, Mumbai
4	Dr.Ketan Jagtap	Lecturer in Mech. Engg, I/c TPO,	Govt. Polytechnic Vikramgad
5	U.A. Agnihotri	Lecturer in Mechanical Engineering	Govt. Polytechnic Mumbai
6	Dr. V. U. Rathod	Lecturer in Mechanical Engineering	Govt. Polytechnic Mumbai

Coordinator,
Curriculum Development,
Department of Mechanical Engineering

Head of Department
Department of Mechanical Engineering

I/C, Curriculum Development Cell

Principal

IMPORTANT NOTE

1. This curriculum document is an important document for reference to the academic activities of the department.

2. Department of Mechanical Engineering/ Government Polytechnic, Mumbai reserves the rights to modify this document as and when required without prior intimation.

3. In case of any error or clarification, Please do not guess but contact to the Head of Department.