GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute of Government of Maharashtra)

Department of Mechanical Engineering

P19R Curriculum

Fourth Semester

GOVERNMENT POLYTECHNIC MUMBAI

(Academically Autonomous Institute, Government of Maharashtra)

Teaching and Examination Scheme (P19R)

With effect from AY 2022-23

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				
ME19R309	MATERIALS TECHNOLOGY	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19R402 ME19R403 ME19R404	**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**
ME19R304	POWER ENGINEERING AND REFRIGERATION & AIR CONDITIONING	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19R306	ADVANCED MANUFACTURING PROCESSES	3	2	--	5	5	60	20	20	25*	--	25	**150**
ME19R307	PRODUCTION AND INDUSTRIAL ENGINEERING	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19R312	BASICS OF MECHATRONICS	3	2	--	5	5	60	20	20	--	--	25	**125**
ME19R104	TECHNICAL COMMUNICATION(MOOC)	--	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,
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: ME19R309				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

Sr. No.	Unit No	COs	Title of the Experiments	Hours
7	5	CO5	Performance of heat treatment on steel sample	4
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

E-References:

1. https://depts.washington.edu/matseed/mse_resources/Webpage/Metals/metalstructure.htm
2. https://www.kemet.co.uk/blog/metallography/what-is-metallography
3. https://web.utk.edu/~prack/MSE%20300/FeC.pdf
4. https://www.youtube.com/watch?v=AH3ekqeiyZo
5. https://www.youtube.com/watch?v=AH3ekqeiyZo
6. https://www.youtube.com/watch?v=fc8zrgYJCJw
7. https://www.youtube.com/watch?v=UuHofNW40Yw
8. http://users.fs.cvut.cz/libor.benes/vyuka/matscienceii/lectures2017/04_Copper%20and%20copper%20alloys.pdf
9. https://web.itu.edu.tr/~arana/ndt.pdf

10. https://www.pmec.ac.in/images/5_Mechanical%20Working%20and%20Testing%20of%20Materials.pdf

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Avinash Jangle	Senior Engineer	DAKA Monolithics Pvt. Ltd., Thane
2	Mr. Dattatraya B. Jadhav	Head, Melting	Mahindra & Mahindra Ltd, Kandivali
3	Dr. W.S. Rathod	Associate Professor	Veermata Jijabai Technical Institute (VJTI), Mumbai
4	Dr. R.L. Doiphode	Lecturer in Mechanical Engineering	Government Polytechnic, Kolhapur
5	Mr. Amol S. Dhande	Lecturer in Mechanical Engineering	Government Polytechnic, Ratnagiri
6	Shri. U.A. Agnihotri	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
7	Dr. V.U.Rathod	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:**ME19R402**				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)**

Unit No	Topics / Sub-topics
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 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

E-References:

1. www.tatamotors.com
2. www.marutisuzuki.com
3. www.auto.howstuffworks.com

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

Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Gopal B. Patil	Senior Engineer	Atul Auto Ltd, Pune
2	Mr. Sagar R. Saymote	Manager Mechanical Design	Induction equipment India Pvt Ltd,Bhosari, Pune
3	Mr. A.G. Joshi	Lecturer in Mechanical Engineering	Government Polytechnic, Ahmadnagar
4	Mr. Kiran B Salunke	Lecturer in Mechanical Engineering	Government Polytechnic, Thane
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 19R404				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:**ME19R304**				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 engines, Comparison of two stroke and four stroke engines; Comparison of C.I.

Unit No	Topics / Sub-topics
	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 plants. Window air-conditioning, split type air-conditioning, car air-conditioning

Unit No	Topics / Sub-topics
	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	04

			find COP.	
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:

Sr. No	Name	Designation	Institute/Organisation
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: ME19R306				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 1.3. **Special Purpose Machines (SPM):** Need, Different layouts of SPM, Advantages and

Unit No	Topics / Sub-topics
	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

E-References:

www.mechanicalbooster.com
www.britannica.com>technology>modificationofbasicmacinetool
www.nptel.ac.in/content/storage/courses/112105127
www.pds.gov.in>downloads>plastic_processing_techniques
www.blog.robotiq.com>whataredifferentypesofindustrilarobots

www.nptel.ac.in/content/storage2>courses>pdf
www.easyengineering.nt>maintenenceengineering
www.forgottenbooks.com>downloads>machinefoundationerection

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
2	Mr. Rao Virbhadra	Assistant Professor	Fr. C.R. College of Engineering, Mumbai
3	Mr. Hiremath P	Sr. Engineer	Reliance Engineering Ltd.
4	Mr. Ambadekar N M	Workshop Superintendent	Government Polytechnic, Thane
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: ME19R307				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 1.3 Plant Layout: Objectives, Types of plant layout, Principles of plant layout design,

Unit No	Topics / Sub-topics
	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 6.4 Design of information display, Design of controls, and environmental factors

Unit No	Topics / Sub-topics
	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

E-References:

1. www.inc.com.>john_-rampton
2. www.vbengg.com/plantlayout-design
3. http://doi.org/10.1007/1-4020-0612-8
4. www.ddegjust.ac.in.upload.pom-326
5. www.ijsdr.org.paper.IJSDR1765093
6. www.yourarticlelibrary.com.costaccounting.timerecording
7. www.researchgate.net.publication.271588974
8. www.ergonomics.org.uk.public.resources
9. www.inestopedia.com/terms/twobinsystem.inventrotycontrol

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:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Hiremath Prashant	Engineer	Reliance Industries Ltd. Navi Mumbai
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,
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: ME19R312				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

E-References:

1. https://nptel.ac.in/courses/112103174/
2. https://mechatronics.colostate.edu/internet-links/
3. https://www.youtube.com/watch?v=4Eaou2pOGGo
4. https://www.youtube.com/watch?v=RoPgRc8aj54
5. https://www.youtube.com/watch?v=ZvUJBeCVhW8
6. https://www.youtube.com/watch?v=nzUyWNPAkiA
7. https://www.youtube.com/watch?v=jLJUIiQREUw
8. https://www.youtube.com/watch?v=5FcY9fDWiJ4
9. https://www.youtube.com/watch?v=B7S_StbcaYc
10. https://www.youtube.com/watch?v=FKDWCxPHvTo
11. https://www.youtube.com/watch?v=Z7pyS5zIbBM
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:

Sr. No	Name	Designation	Institute/Organisation
1	Mr. Sachin Khalkar	Deputy Manager	Mahindra & Mahindra Ltd Nashik
2	Mr. Tushar Mestry	Deputy Manager, Production	Jurchen Technology India Pvt LTD, Boiser
3	Mr. Yogesh Gaidhani	Head of Department	K K Wagh Polytechnic Nashik
4	Mr. Gajanan Gore	Lecturer in Mechanical Engineering	Government Polytechnic Jalna
5	Mr. K. Z. Dhangare	Lecturer in Mechanical Engineering	Government Polytechnic, Mumbai
6	Miss. A. R. Hagawane	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