Table of Content

Programme Code : **Mechanical Engineering**											
Course Code : **ME 11 302**				Course Title : **Machine Design**							
				C / O : **Compulsory**							
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
4	-	2	6	4 hrs	2 Tests of 1.5 Hour each	80	20	-	25*	25	150
*Practical exam by internal and external examiner.											

Rationale:

It is an applied technology subject. A diploma holder in mechanical discipline is expected to design and draw simple machine components used in industries. Fundamental knowledge of Applied Mechanics, Strength of Materials, Engineering Materials and Theory of Machines is essential. Subject aims at developing analytical abilities to give solutions to engineering design problems.

Objectives: The student will be able to:

1. Analyze the various modes of failure of machine components under different load patterns.
2. Design and prepare part and assembly drawings.
3. Use design data books and different codes of design.
4. Select standard components with their specifications from manufacturer's catalogue.
5. Develop drawings on CAD software

Section –I (40 Marks)			
Topic No	**Contents**	**Hrs.**	**Marks**
1	**Introduction to Design** **1.1 Basic Design Considerations** 4 • Design philosophy and Procedures • General Considerations in Design • Types of loads, concepts of stress ,strain, Stress – Strain Diagram for Ductile and Brittle Materials, Types of Stresses such as Tension, Compression, Shear, Bearing pressure • Intensity, crushing, bending and torsion, Principle • Stresses(Simple Numerical) • Concept of Creep, Fatigue, S-N curve, Endurance Limit.	12	14

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	1.2 Factors in Design and material properties 6 • 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 introduction to International standards, advantages of standardization, use of design data book, use of standards in design and preferred numbers series. **1.3 Theories of Elastic Failures** 2 • Principal normal stress theory, Maximum shear stress theory & maximum distortion energy theory. **1.4 Modern Design considerations** 2 • **Design for safety**:-human, ecology, societal consideration & Concept of Product Design, System Design & Creativity in Design, Ergonomics and aesthetic considerations in design		
2	**Design of Joints, Levers and Offset links** **2.1** Design of Cotter Joint, Knuckle Joint, Turnbuckle **2.2** Design of Levers:- Hand/Foot Lever & Bell Crank Lever, Lever for lever safety valve, Design of Off-set links, C – Clamp, Overhang Crank.	08	12
3	**Design of Shafts, Keys and Couplings** **3.1 Design of shaft and key** • 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 • Rectangular, parallel sunk keys, • Effect of Keyways on strength of shaft. **3.2 Design of Couplings** • Protected type Flanged coupling, • Bush-pin type flexible coupling.	12	14
	Section –II **(40 Marks)**		
4	**Design of Power Screws** **4.1 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. **4.2** Design of Screw Jack, Toggle Jack (only screw and nut).	12	12

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5	**Design of springs** **5.1** 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. **5.2** Design of Helical tension and compression springs subjected to uniform applied loads like I.C. engine valves, weighing balance, railway buffers and governor springs.	08	10
6	**Design of threaded and welded joints** **6.1** Stresses in Screwed fasteners, bolts of Uniform Strength. Design of Bolted Joints subjected to eccentric loading. **6.2** Design of parallel and transverse fillet welds, axially loaded symmetrical section. 6.3 ASME codes for welded joints	06	10
7	**Antifriction Bearings** **7.1** Classification of Bearings – Sliding contact & rolling contact. Terminology of Ball bearings – life load relationship, basic static load rating and basic dynamic load rating, limiting speed. Selection of ball bearings using manufacturer's catalogue. (Visit website: http://www.skf.com/portal/skf_ca/home/library?contentId=151382)	06	08

List of Practicals:

1. **Design Project No. 1**

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 shaft, key and coupling. Also select suitable Ball Bearing from Manufacturer's catalogue. 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)

2. **Design Project No. 2**

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, Toggle Jack screw, Bottle type 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)

3. Prepare CAD Drawing for project No 1 or 2 in practical and print out of sheet should be attached .

Assignments :

- Design and draw following components for a given load
  Cotter Joint, Knuckle Joint, Turn Buckle, Bell Crank Lever, Off – Set link, Arm of Pulley (One example on each component)

- Design of Helical Springs, Screwed joints, Welded joints with free hand sketches. (One example on each component)

Learning Resources:

1. **Books:**

Sr. No.	Title	Author	Edition	Publisher
1	Machine Design	RS Khurmi and Gupta	14th	S. Chand
2	Machine Design	VB Bhandari	3rd	Tata Mc-Graw Hill
3	Machine Design	U C Jindal	2 reprint	Pearson Education India
4	Mechanical Engg. Design	Richard G Budynas,J. Keith Nisbett	9th	Tata Mc-Graw Hill
5	Theory and problems of Machine Design	Hall,Holowenko, Laughlin	Reprint 2005	Mc-Graw Hill
6	Design Data Book	PSG	8th	PSG College of Technology Coimbatore
7	Fundamentals of machine components design	Robert C.Juvinall Kurt M Marshek	3rd	Wiley India Edition

2. **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
   h) SKF Catalogue for Bearings

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Principal
Government Polytechnic, Mumbai-51

Programme Code : **Mechanical Engineering**											
Course Code : **ME 11 305**				Course Title : **Project & Seminar Stage-I**							
				C / O : **Compulsory**							
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
-	-	4	4	-	-	-	-	-	25	-	25
*Practical exam by internal and external examiner.											

Rationale:

Diploma technicians come across different types of problems of various natures. To solve those problems they are required to know designs, drawings, production, inspection installation, commissioning of machine tools. In order to develop them systematically for different problem solving needs, by previous technical knowledge, and skills learnt in previous semester, this subject is incorporated in the curriculum.

Objectives:-

At the end of the course students will be able to:

- Identify, analyze and define the problems.
- Work out the different solutions to the problems.
- Select most appropriate solution.
- Design develop manufacture the machine tools and equipment.
- Acquiring higher knowledge about recent trend in Mechanical Engineering.
- Work effectively in team.
- Manage conflicts.
- Prepare effective documents.
- Prepare learning materials.
- Acquire effective presentation skills.
- Acquire effective communication skills.
- Develop ones personality

Methodology:

- This course will be spread over two semesters i.e. fifth and sixth semester.
- Course registration will be at the beginning of the fifth semester.
- A batch consisting of maximum four students.

- A project diary 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.
- 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, and 12 respectively. The report should consist of text, drawings, graphs, tables, photographs etc. of about 5000 words.
- Batch formation, project identification, project selection, survey work, seminar presentation should be completed during fifth semester.

Following is the suggestive list of topics for selection of project.

- A Fabrication of small machine / test rig/ devices etc.
- Design and fabrication of mechanisms, machine and devices etc.
- Development of computer programming.
- Industry supported project.
- Literary based survey project.
- Investigative type project.
- Maintenance based project.
- Industrial Engineering based project.
- Low cost automation project.
- Creativity based engineering project
- Environment base project.
- Market Survey project.
- Project in recent trends in mechanical engineering.
- Appropriated technology related to rural areas.

Seminar

- Every student will prepare and deliver the seminar.
- Seminar can be on project selected by the batch.
- Use of audio visual and / or power point presentation is desirable.
- Presentation will be for @ 15 minutes including 5 minutes of question and answer.
- Seminar topic should be selected in consultation with project guide.
- Seminar paper should be submitted to the guide well before the presentation.
- Seminar should be presented during fifth semester.

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शास. कला तंत्रनिकेतन, मुंबई-११.

Programme : **Diploma in Mechanical Engineering**											
Course Code : **ME11 401** 304 & 401				Course Title : **Physical Metallurgy & Materials** C / O : **Compulsory**							
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
03	-	02	05	3 Hours	2 Tests of 1 Hour each	80	20	-	25*	25	150
(*) indicates assessment by Internal and External examiners.											

Rationale:

Mechanical engineering technicians are expected to perform testing, treatments and identification of materials. Also they should have basic knowledge of heat treatments of steel and cast iron. They should know the materials and their properties, applications, alloys etc. This will help for proper selection of material for designing the various mechanical elements. The microscopic study will help them to understand the reasons of failure and their remedies.

Objectives:

Students will be able to –

- Identify the type of material and its properties
- Prepare samples for metallographic observations
- Understand the Iron-Iron-carbide diagram
- Suggest the heat treatment required for the product
- Understand various ferrous and nonferrous materials, their composition, applications, properties etc.
- Understand the composite materials and their applications
- Understand the powder metallurgy and their applications

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Section I (40 Marks)			
Topic No.	**Contents**	**Hours**	**Marks**
1.	**Structure of Materials** 1.1 Crystal Structure, Miller indices, APF, No. of atoms per unit cell, co-ordination number 1.2 Imperfections in crystal	4	8
2.	**Equilibrium Diagrams** 2.1 Terminology, Hume-Rothery rules, Gibbs Phase rule 2.2 Plotting of equilibrium diagram, Lever rule 2.3 Iso-morphous systems 2.4 Eutectic systems	4	8
3	**Ferrous Metals** 3.1 Steels – Fe-Fe3C diagram, Classification of Steel, Microstructure of steel, Widmanstatten structure, Property variation with microstructure, Applications 3.2 Cast Irons – Classification – White, Malleable, Grey, Nodular, factors affecting microstructure, Applications	8	12
4	**Alloy Steels** 4.1 Alloying elements – Types , Effect, Need, Applications 4.2 Classification of alloy steel 4.3 Stainless steel – Types, Applications, Composition 4.4 Tool Steel - Types, Applications, Composition 4.5 HSLA steels - Types, Applications, Composition	8	12

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Section II (40 Marks)			
Topic No.	Contents	Hours	Marks
5	**Heat Treatment of Steels** 5.1 TTT Diagram 5.2 Need of heat treatment, Definition, Quenching medias 5.3 Types of Heat Treatment processes - Annealing, Normalizing, Hardening, Tempering, Carburizing, Nitriding, Flame hardening and Induction Hardening 5.4 Hardenability – Definition, measurement 5.5 Vacuum Heat Treatment	9	14
6	**Non Ferrous Metals and Alloys** 6.1 Need, Classification and applications 6.2 Aluminum – Properties, Alloys, Applications 6.3 Copper - Properties, Alloys, Applications 6.4 Titanium - Properties, Alloys, Applications 6.5 Magnesium – Properties, Alloys, Applications	9	10
7	**Composites** 7.1 Definition, Types, Elements 7.2 Fiber reinforced composites 7.3 Polymer matrix composites 7.4 Metal-matrix composites	3	8
8	**Powder Metallurgy** 8.1 Need of powder metallurgy, Definition 8.2 Steps in powder metallurgy process 8.3 Preparation of powders – Mechanical, Electrolytic, Chemical reduction and Atomization process 8.4 Properties of metal powders and Applications	3	8

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List of Practical:

Any ten assignments / practicals –

1. Study of crystal structure
2. Assignment on Fe – Fe3C diagram
3. Study of Metallurgical microscope in the laboratory
4. Preparation of Metallographic sample by ASTM method
5. Study of microstructure of Steel on prepared sample in the laboratory
6. Study of microstructure of Cast iron on prepared sample in the laboratory
7. Study of microstructure of Non-ferrous metal on standard samples in the laboratory
8. Any one Heat treatment of steel in the laboratory
9. Hardness measurement on available machine in the laboratory
10. Demonstration on Harden-ability measurement
11. Magnetic crack detection test in the laboratory
12. Demonstration on Ultrasonic crack detection test
13. Visit the website of any two Steel manufacturers and compare their product specifications.

Note – Assignments from 1 to 6 are compulsory and any 4 from remaining.

Reference Books:

Sr.No.	Author	Title	Publication
1	V.D.Kodgiri	Material Science & Metallurgy	Everest Publishing house
2	Willium D. Callister	Material Science & Engineering	John Wiley & Sons
3	S.H.Avner	Introduction to Physical Metallurgy	Tata McGraw Hill Publishing Co.Ltd.
4	ASM International	Practical Heat treating	ASM International
5	Angelo and Subramaniun	**Powder metallurgy:** science, technology and applications	PHI Learning Pvt. Ltd., 2008
6	D. Hull and T.W. Clyne	An Introduction to composite materials	Cambrige University Press

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Principal
Government Polytechnic, Mumbai-51

Programme : **Mechanical Engineering**											
Course Code : **ME 11 402**						Course Title : **Computer Aided Design**					
						C / O : **Compulsory**					
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
-	-	4	4	-	-	-	-	50*	-	50	100
(*) The assessment is internal and external											

Rationale: In order to survive in the today's competitive market entrepreneur need to ensure that their products get designed and manufactured in the minimum possible time, and in the lowest possible cost, without compromising on the quality aspect. Therefore design, engineering and production department must work together in an integrated fashion. The advent of CAD has paved the way for highly flexible, accurate, fast and integrated approach for creating and manufacturing products and its components. The process begins with designing products as 3D digital solids or surfaces models. 3D modeling is a process of developing a mathematical representation of any 3 dimensional objects. Three dimensional computer graphics are widely used for product design, assembly design etc.

3D models are usually generated on the computer by using some kind of solid modeling software's or CAD (Computer Added Design) software. Use of CAD software has become a need of time in the industries. The industry expects diploma holder should have the knowledge of solid modeling software to visualize the machine components & assembly like automobiles, machine tools and earth movers etc. and have ability to work on CAD software directly.

Objectives: After completion of the course the student will be able to

- Create 2D sketches
- Constraining of the geometry
- Create 3D solid models
- Create 3D surface models
- Create assemblies
- Generate orthographic drawing from a solid models
- Apply dimensions, tolerances and geometrical tolerances.

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Topic No	Contents	Hrs.
1	**Introduction**: Definitions, Historical developments, Geometrical modeling, parametric equations, Co-ordinate system **Design of curves**: space curve, Four point form, straight lines, Bezier curve, spline curve **Transformation**: Translation, Rotation, Scaling, Symmetry and Reflection, Orthographic Projection, Axonometric Projection, Oblique Projection, Perspective Projection	08
2	**Solid modeling Fundamentals**: Topology of closed paths, Topology of closed curved surfaces, Generalized concept of boundry, set theory, Boolean operators. Euler operators **Solid modeling construction**: Boolean models, sweep representation, CSG, Boundry representation. **Solid modeler** Applications, Benefits, Need, Hardware Requirements, Different Software packages used for Solid Modeling.	08
3	**Getting started with solid modeler** • Open a new file • Open a part file • Saving and closing part file • Mouse functionality • Absolute coordinate system • Work coordinate system • Toolbars • Getting help • Exit	04
4	**Working in 2 D environment** **Working in Sketcher mode** • Selection of sketch plane • Orient view to sketch • Sketch curve toolbar:– Line, Profile, Circle, Arc, spline Rectangle and their sub options. quick trim, quick extend, mirror, offset etc.	08

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	Constraints • Dimensioning constraint, • Geometrical constraint. • show all constraints, show-remove constraints	
5	**Working in 3 D environment** **Form features** • Introduction of form features • Types of features • Adding and removing buttons • Reference feature: datum plane, datum axis, datum CSYS, point, point set, plane • Design feature : extrude, revolve, sweep along guide, block, cylinder, cone, sphere, tube, hole, boss, pocket, pad, slot, groove **Feature operation** • Taper • Edge blend • Chamfer • Threads • Trim body • Split body • Instance: associative copy • Boolean operations combine bodies: unite, subtract, intersect	12
6	**Free form feature** • introduction • creating free form feature from points • creating free form feature from section strings : flat surfaces ,Open and closed end surfaces ruled surfaces, through curve surfaces, through curve mesh surfaces, swept surfaces • Creating surface by defining its boundaries, Blended surface, Conic surface, N sided surfaces • offset surfaces, extensions of surfaces	8
7	**Assembly modeling** • Introduction • Top-Down modeling • Bottom-UP modeling • Mating conditions: mate, align, angle, parallel,	12

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	perpendicular, center, distance, tangent • Exploded view of assembly	
8	**Drafting** • Drafting window • Insert sheet • Insert: base view, projected views(will include all types of views – front view, top view, side view, sectional views, isometric views, auxiliary views) • Dimensioning, dimensions style, dimensional and geometrical tolerances. • Bill of material – Prepare part list table and name plate	06

Laboratory work and Term work:

List of practicals:

1) Implementation of algorithm of any space curve or any transformation in C language
2) Demonstrate the use, interface and handling and operating functions of Solid modeler.
3) Demonstrate the working in the sketching mode including Selection of sketching plane, related toolbars and tools and their handling and uses, constraining the sketch. Prepares 2 D sketches (minimum 5 different 2 D sketches).
4) Prepare solid components from 2 D sketches involving use of form features (at least 6 solid models).
5) Modify solid model Components.
6) Demonstrate the use of free form feature and Prepare 4 different models using different free form features.
7) Demonstrate the use of Assembly Modeling feature and Prepare assembly drawing from machine components (4 assembly drawings).
8) Explode assembly drawing of earlier prepared assemblies.
9) Prepare two digital drafting's (orthographic & sectional views) of earlier prepared models/assembly using Drafting feature.
10) Plotting of drawings on A2/A3 size sheet.

Note: Use of any high end Solid Modeling Software of Latest Version is recommended. (Unigraphics NX8, Creo 1 or ProE 5, Autodesk inventor11 etc)

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Text Books:

Sr. No.	Author	Title	Publisher / Edition
1	Michel E.Mortension	Geometric modeling	John Wiley
2	Ibrahim Zeid	CADCAM theory and practice	McGraw hill
various User's guide or manuals of advance 3D modeling software			

Website:

www.plm.automation.siemens.com

www.learningexchange.ptc.com

www.ptc.com

www.usa.autodesk.com/autodesk-inventor

Reference Books:

Sr. No.	Author	Title	Publisher / Edition
1	David F.Rogers J.Alan Adams	Mathematical Elements for Computer Graphics	Tata McGraw hill

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Principal
Government Polytechnic, Mumbai-51

Programme Code : **Mechanical Engineering**											
Course Code : **ME 11 403**				Course Title : **Advanced Manufacturing Processes**							
				C / O : **Compulsory**							
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
2	-	4	6	3 hrs	2 Tests of 1 Hour each	80*	20	25*	25*	25*	150
(*) indicates assessment by Internal and External examiners.											

Rationale:

After getting conversant with the basic manufacturing processes and production processes, it is necessary for a technician to know about the advancements in the area of manufacturing and production processes. The subject will impart knowledge & skills necessary for working in modern manufacturing environment. This subject will help the student to get familiarized with working principles and operations performed on nontraditional machines, machining center, SPM, automated machines and maintenance of machine tools.

Objectives:

- Know the Operation and control of different advanced machine tools and equipments.
- The student will be able to know different nontraditional machining processes, CNC Turning & CNC milling machine.
- Understand the working of Special Purpose Machines.
- Know the Procedure & method of erection, testing & maintenance of machine tool.
- Produce jobs as per specified requirements by selecting the specific machining process.
- Adopt safety practices while working on various machines.
- Develop the mindset for modern trends in manufacturing and automation.

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SECTION – I (MARKS 40)			
To pic. No.	**Contents**	**Hrs.**	**Marks**
1.	**GRINDING MACHINES** Introduction, types of grinding, Types of grinding machines. Grinding operations, Grinding Wheel, abrasives, bonds, grit, grade, structures, standard marking systems, dressing, truing. Safety on grinding machines and personal protective equipment (PPE).	05	12
2.	**SURFACE FINISHING OPERATIONS** Introduction, Lapping, honing, super finishing, polishing, Electroplating, galvanizing, Metal spraying. Safety in Surface finishing operations.	03	08
3.	**COMPUTER NUMERICAL CONTROL MACHINES** **Fundamentals-** Introduction, Advantages of CNC, components of CNC, axis identification, Classifications of CNC, absolute system, incremental system, part programming codes (G, M, F S T) **Machine tools -** Types of CNC machines- (Turning & Machining centers and their configurations), Construction features of CNC machines- stepper & servo drive motors, Slide ways, Ball screws, Automatic tool changer (ATC), Pallets, Swarf removal systems **Part Programming for CNC Machines** **Manual Part Programming -** Process planning, NC words, Details of G and M codes. , Programming formats, Part programming for CNC lathe and milling machines. Canned cycles, subroutines and Do loops. Tool radius and length compensations. Introduction to computer aided part programming. Safety in CNC machine operation, types of injuries and personal protective equipment (PPE).	08	20

SECTION – II (MARKS 40)			
To pic. No.	**Contents**	**Hrs.**	**Marks**
4.	**SPECIAL PURPOSE MACHINES** Concept of low cost automation, General elements of SPM and automation, Elementary SPM machines like Turret & Capstan lathe, Copying machine. Productivity improvement by using SPM.	03	08

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5.	**NON-CONVENTIONAL MACHINING** Need and importance, classification of non-conventional machining, setup, working Principal, process parameters, advantages, disadvantages, applications and safety aspects of following process. • Electro discharge machining (EDM) • Wire-cut Electro discharge machining (WEDM) • Electro chemical machining (ECM) • Abrasive Jet Machining (AJM) • Laser beam machining (LBM)	06	16
6.	**PLASTICS AND THEIR PROCESSING** Introduction, types of plastics and plastic alloys, Thermoplastics, Thermosetting plastics, Elastomers, materials for processing plastics. Processing's- compression moulding, transfer moulding, injection moulding, extrusion, Calendaring, Thermoforming, blow moulding. Safety in plastic industry.	03	08
7.	**ERECTION, TESTING & MAINTENANCE OF MACHINE TOOLS** Installation of machine tools: Location, lifting and unloading of machines, Equipments such as pulley blocks, Gantry, Derricks, Shear legs, Rollers and pinch bars. Slinging of shaper, milling machine. Lathe, precaution in loading and unloading. Foundation for machine tools. Types of Foundations, Foundation plans for lathe and milling machines, Erection and Leveling, Grouting. Erection procedure, bed preparation, Introduction, Need for maintenance, Types of maintenance, Preventive Maintenance - Benefits, components of Preventive Maintenance, Maintenance manual, and Maintenance records. Safety aspects.	04	08

List of practical's:-

1. Eccentric turning one job ± 0.5mm
2. One simple job on CNC Turning (Group of 6 – 8 students)
3. One simple job on CNC Milling machine (Group of 6 – 8 students)
4. Demonstration on Computer aided part programming.
5. Demonstration of at least one nontraditional machining process.
6. One assignment on machine tool installation procedure.
7. Testing of machine tool. Ex. Drilling machine, Lathe machine & milling machine etc; in machine shop.
8. Dismantling and assembly of any one machine component in machine shop for maintenance.

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Notes:

- Journal / Work Book based on above term work.
- The workshop instructors should prepare specimen job in each shop as demonstration practice before the student (as per the drawing given by subject teacher / workshop superintendent)
- Theory behind practical is to be covered by the concerned subject teacher / workshop superintendent.
- Workshop diary should be maintained by each student duly signed by respective shop instructors.

REFERENCES:

Author	Title	Publisher
S. K. Hajra Chaudary, Bose, Roy	Elements of workshop Technology – Volume I & II	Media Promoters and Publishers limited
D. L. Wakyl	Processes and design for manufacturing	Prentice Hall
O. P. Khanna and Lal	Production Technology - Volume I & II	--
W.A.J. Chapman	Workshop Technology -Volume I , II & III	Viva Books (p) Ltd.
Jhon A Schey	Introduction to Manufacturing Processes	McGraw Hills International
M. Adithan and A. B. Gupta	Manufacturing Technology	New Age International
P. N. Rao	Manufacturing Technology Metal Cutting & Machine tools	Tata McGraw-Hill
Pabla B. S. M. Adithan	CNC machines	New age international Limited
Steve Krar, Arthur Gill, Peter Smid	Computer Numerical Control Simplified	Industrial Press Inc.
James Madison	CNC Machine Handbook	Industrial Press Inc.

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001

Programme : **Mechanical Engineering**											
Course Code : **ME 11 405**						Course Title : **Mechanical Measurement**					
						C / O : **Optional**					
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
3	-	2	5	3 hrs.	1 hrs.	80	20	-	25*	25	150
* Indicates Oral Examination is to be conducted jointly by both internal & external examiners											

Rationale:

The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations, refinements. The course aims at making a Mechanical Engineering student familiar with the principles of instrumentation, transducers & measurement of non electrical parameters like temperature, pressure, flow, speed, force and stress and methods of control systems for engineering applications

Objectives:

Student will be able to:

1. 1. Understand principle and construction of transducers
2. Draw the diagram of different transducers.
3. Draw the Input/output characteristics of different transducers.
4. Understand principle of process measurement systems.
5. Measure the process parameters such as pressure, temperature, flow etc.
6. Identify the specifications of transducers.
7. State the advantages and disadvantages of transducers.
8. Select & calibrate transducer.

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Topic No	Contents	Hours	Marks
	Section-I		40
1	**Introduction to Measurement/Instrumentation System** 1.1 Introduction to Measurement System 1.2 Static Characteristics of Instruments: Accuracy, Precision, Range, Span, Static error, Static calibration, Linearity, Sensitivity, Resolution, Threshold, Repeatability, Reproducibility, Reliability, Hysteresis, Dead zone, Drift and Reliability. 1.3 Dynamic characteristics of Instruments: Speed of response of first and second order instruments , Fidelity, Dynamic error, and Dead time. 1.4 Types of instrument errors, Sources of errors and their remedies 1. 5 Calibration and Standards – Necessity of calibration, Calibration Definition and process, method of calibration, Types of Sandards- International, Primary, Secondary, Working standards. 1.6 Transducers: Definition and examples, Classification, and selection criteria of transducers.	06	10
2	**Displacement, Speed, Acceleration and Force Measurement** 2.1 Transducers for displacement measurement, Potentiometers, LVDT, RVDT, Capacitance type, Digital transducers (optical encoder), Nozzle flapper transducer. 2.2 Strain measurement: Theory of Strain Gauges, Gauge factor, Temperature compensation, Bridge circuit 2.3 Orientation of Strain Gauges for Force and Torque measurement, Strain Gauge based Load Cells and Torque Sensors. 2.4 Measurement of angular velocity: Tachometers, Tachogenerators, digital tachometers. 2.5 Eddy Current Dynamometer and Piezoelectric accelerometers. (Diagram, construction, operation, selection criteria, advantages and applications of above transducers.)	08	14
3	**Temperature Measurement** 3.1 Temperature: definition, temperature scales, temperature scale conversion relations, and International Practical Temperature Scale (IPTS) reference points. Non electrical-type Temperature Measurement: 3.2 Liquid in Glass thermometers, 3.3 Filled system thermometers, 3.4 Bimetallic strip thermometers (Principle, type of fluid/material used, types ,construction, working, range, advantages and disadvantages.) Electrical -type Temperature Measurement : 3.5 Resistance Temperature Detectors (RTDs), RTD measurement circuits: 3-wire and 4-wire compensation circuits, 3.6 Thermistor s- NTC and PTC type, 3.7 Thermocouples-Principle, thermocouple effects and laws,	10	16

	Thermopile, T/c cold junction compensation techniques, Thermocouple tables, characteristics, and calibration methods. Pyrometers: 3.8 Total Radiation Pyrometer 3.9 Optical Pyrometer 3.10 Integrated-Circuit Temperature Sensors. (Principle, construction, working, materials, range, application, advantages & disadvantages.)		
	Section II		**40**
4	**Pressure Measurement** 4.1 Definition, different types of pressure. 4.2 Manometers: U-tube-type, well -type, inclined manometers, and barometer. 4.3 Elastic pressure sensors/ pressure gauges: Bourdon tubes, bellows, diaphragms. 4.4 Measurement of vacuum: McLeod gauge, Thermal conductivity gauge- pirani gauge, Ionization gauge. 4.5 Electrical/Electronic pressure sensors: strain gauge-type, capacitive-type, inductive-type, and piezo-electric-type pressure sensors. (Diagram, construction, operation, selection criteria ,advantages, and applications and above pressure transducers.) 4.6 Electronic type Differential Pressure transmitter- construction, operation, specifications and applications. 4.7 Calibration of pressure transducers using U-tube manometer and dead weight tester/comparator.	10	15
5	**Flow Measurement** 5.1 Flow principles: Brenoulli's law, flow through process pipe-equation, Reynold's number and flow types. 5.2 Flow-meters classification 5.3 Variable head flowmeters: Orifice plates, venturi-meter, flow nozzle, pitot tubes, and annubar. 5.4 Variable area flowmeter: Rotameter. 5.5 Velocity-type flowmeters: Turbine-type , magnetic –type , votex shedding type, ultrasonic c type flow meters. 5.6 Positive-Displacement type Flowmeters: rotary-vane and nutating-disk type flowmeters. 5.7 Coriolis Mass flowmeters. 5.8 Flow meter selection procedure & example. (Diagram, construction, operation, selection criteria, advantages & applications of above transducers.)	10	15
6	**Level Measurement** 6.1 Sight-type Instruments: Glass gauges, displacers, tape float 6.2 Pressure-type Instruments: Differential pressure, bubblers, and Diaphragm. 6.3 Electrical- Instruments: Capacitance probes, resistance tapes, and conductivity probes.	04	10

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	6.4 Sonic- type Instruments: Ultrasonic –type level measurement 6.5 Radiation-type Instruments: Nuclear –type , microwave-type, and radar-type level measurements. (Diagram, construction, operation, selection criteria, advantages & applications of above transducers and switches.)		

Laboratory work and Term work:

List of Practicals (Any eight):

Understand the methods of measurements and instrument characteristics with illustration.

1. Measure the linear displacement using L.V.D.T. and plot its characteristic.
2. Measurement of displacement using potentiometer- resistive transducer.
3. Measurement of angular displacement using capacitive transducer
4. Angular speed measurement using digital tachometer.
5. Measurement of temperature by using Thermocouple/ RTD/ Thermistors.
6. Pressure measurement Using
   a. Well/ U-tube/ inclined tube manometers
   b. Bourdon Tubes– C type, Helical type, Spiral type
   c. Capsules Bellows
7. Liquid Level measurement Using
   i. Capacitive transducers
   ii. Bubbler method
8. Flow measurement
   i. using orifice meter and manometer.
   ii. using Rotameter.
9. Flow and liquid level measurement using DP transmitter.
10. Calibration of pressure gauge by using dead weight pressure gauge tester.
11. Calibration of temperature transducers.
12. Measurement of force & weight by using a load cell.

Mini project-A group of 4 students shall take a mini project of searching information about advanced instrumentation system using internet and submit its report.

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Learning Resources:

Books:

Sr. No.	Author	Title	Publication
01	D.S.Kumar	Mechanical Measurements & Control	Metropolitan Publications, New Delhi
02	R.K.Jain	Mechanical & Industrial Measurements	Khanna Publications, New Delhi
03	A.K.Sawhney	Mechanical Measurements & Instrumentation	Dhanpat Rai & Sons, New Delhi.
04	E. O. Doebelin	Measurement Systems	Tata McGraw Hill Publications
05	R.V. Jalgaonkar	Mechanical Measurement & Control	Everest Publishing House, Pune
06	C.S. Narang	Instrumentation Devices & Systems	Tata McGraw Hill Publications
07	B.C.Nakra and K.K.Chaudhary	Instrumentation, Measurement and Analysis	Tata Mc Graw Hill Publication
08	Thomas Beckwith	Mechanical Measurement	Pearson Education
09	James W Dally	Instrumentation for Engg. Measurement	Wiley India
10	**Thomas A. Hughes**	Measurement and Control Basics	**ISA Press**

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शासकिय तंत्रनिकेतन, मुंबई-५१.

Principal
Government Polytechnic, Mumbai-51

Programme Code : **MECHANICAL ENGINEERING**											
Course Code : **ME 11 406**				Course Title : **AUTOMOBILE ENGINEERING**							
				C / O : **Optional**							
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
03	-	02	05	3 hrs	2 Tests of 1 Hour each	80	20	-	25*	25	150
(*) The assessment is internal and external.											

RATIONALE:-

Diploma engineer may have to work in an Automobile Industry, Garage, or as a vehicle inspector in RTO. He must know the parts of automobile, maintenance work of automobile, pollution control Norms of automobiles & working of different systems of an automobile.

This course is designed mainly to impart knowledge related to basic understanding of working of different parts of a automobile, related maintenance work, awareness of pollution control norms and safety RTO rules and regulations.

OBJECTIVES: - Students will be able to

1. Identify Parts of automobile & understand their working.
2. Carry out maintenance work of automobile.
3. Measure emissions of automobiles.
4. Trace the fault in automobiles.
5. Know the role & rules of RTO.

Section I

Unit	Theory	Hrs.	Marks
1	**Introduction of Automobile** 1.1 Definition, difference between self-propelled & ordinary vehicle. Four stroke IC Engine working. 1.2 Classification of automobiles-according to type of power plant, fuel used, body shape, drives(front wheel, rear wheel & 4WD) 1.3 Vehicle layouts & types 1.4 Automobile market in India. major manufacturers, their products & collaboration	4	6
2	**Chassis** 2.1 Types of chassis- frame frameless, unitary (combination of frame & frameless) construction 2.2 Chassis layout 2.3 Forces acting on chassis 2.4 Functions of chassis	4	6

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3	**Body construction** 3.1 Body construction- Types of bodies, functions of body. 3.2 Nomenclature of car body, introduction of aerodynamic shape of car body.	4	4
4	**Suspension System** 4.1 Objectives, types of suspension. 4.2 Working principle of leaf spring, rigid axle suspension. 4.3 Introduction to air suspension 4.4 Construction& working of McPherson& wishbone trailing link suspension. 4.5 Construction & working of telescopic shock absorber.	6	12
5	**Steering System** 5.1 Objectives, functions & types of steering system 5.2 Construction & working of steering system. 5.3 Wheel alignment, camber, caster, toe-in, toe-out, kin pin inclination 5.4 Ackerman's Principle.	6	12
	Total	**24**	**40**

Section II

Unit	Theory	Hrs.	Marks
6	**Transmission system** 6.1 Clutch – Construction and working of single plate & multiplate clutch, faults & remedies in clutches. 6.2 Manual Gear box – Necessity of a Gear Box, tractive resistance and tractive effort Construction & Working of constant mesh & synchro-mesh Gear Box functions, overdrive, transfer case. 6.3 Automatic Transmission: Construction and working of Torque Convertor, Working of a simple automatic transmission. 6.4Final drive necessity, construction & working of propeller shaft & differential. 6.4 Axles – live & dead axles, types of rear axles& their applications. 6.5Tyres- Types, functions, construction of tyres.	10	20
7	**Electric system** 7.1 Dynamo, starter (Bendix, solenoid & over running clutch), cut-out relay. 7.2 Construction and working of Lead-acid battery, Charging of battery 7.3 Construction & working of alternator.	4	6
8	**Braking System** 8.1 Types (mechanical & hydraulic), function. 8.2 Construction & working of mechanical brakes.	4	4

	8.3 Construction & working of hydraulic brakes comparison between disc & drum brake, master cylinder, Tandem cylinder.		
9	**Exhaust system and Pollution control** 9.1 Constituents of exhaust gas of automobiles, measurement of HC, CO & CO_2. 9.2 Legal aspects regarding pollution control. Bharat and Euro norms 9.3 Catalyatic convertors used in Modern vehicles.	4	6
10	**R.T.O. rules & regulations** 10.1 Introduction of RTO, Duties of RTO 10.2 Formalities of RTO in urban area.	2	4
	Total	**24**	**40**

List of practicals

1. Identification and functions of all parts of an automobile (2 wheeler & 4 wheeler)
2. Study of leaf spring, torsion bar, sway bar, dependent & independent suspension.
3. Dismantling of gearbox cover & demonstration of constant mesh & synch-mesh gearbox with gear shifting arrangements.
4. Dismantling & assembling of single plate & multi-plate clutch.
5. Dismantling & assembling of axles.
6. Dismantling & assembling of master cylinder of brakes.
7. Study of steering system.
8. Study of wheel alignment and wheel balancing
9. Study of braking system.
10. Measurement of HC and CO by exhaust gas analyser

Mini Project (Compulsary)

1. A Details report based on any one light/heavy commercial vehical. The report should emphasis on sailent features, specification, cost etc

Learning Resources:

SN	Author	Title	Publisher
1	C. P. Nakra	Automobile Engineering	Tata McGraw Hill
2	William H Cruse	Automobile Engineering	PHI
3	Kripal Singh	Automobile Engineering Vol I & II	PHI
4	Harbans Singh Reyat	Automobile Engineering	Charotar Publication

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Principal
Government Polytechnic, Mumbai-51

Programme Code : **Mechanical Engineering**											
Course Code : **ME 11 407**				Course Title : **Non Conventional Energy Sources**							
Prerequisite : **Nil**				C / O : **Optional**							
Credits				Duration of Written Examination		Examination Scheme					
TH	TU	PR	TOTAL	TH	TS	TH	TS	PR	OR	TW	TOTAL
3	-	2	5	3hrs	2 Tests of 1 Hour each	80	20	-	25*	25	150
* Indicates Oral Examination is to be conducted jointly by both internal & external examiners											

Rationale:

Modern society relies on stable, readily available energy supplies. Renewable energy is an increasingly important component of the new energy mix. The course covers energy conversion, utilization and storage for renewable technologies such as wind, solar, biomass, fuel cells and hybrid systems. Thermodynamics concepts (including the first and second law) form the basis for modeling the renewable energy systems. The course also touches the environmental consequences of energy conversion and how renewable energy can reduce air pollution and global climate change.

Objectives: After the successful completion of this course, student will be able to:

1. List and generally explain the main sources of energy and their primary applications in the India, and the world.
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
3. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
4. List and describe the primary renewable energy resources and technologies.
5. Make comparisons among energy uses, resources, and technologies.
6. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
7. Discuss Emerging Energy Technologies and their future

Section-I (40 Marks)

Topic No	Contents	Hrs.	Marks
1	**Introduction to Non –conventional sources of energy** 1.1 What is energy? Law of conservation of energy 1.2 Introduction to conventional energy sources & non conventional sources of energy. 1.3 Comparison between energy sources 1.4 Present scenario in energy crises in India 1.5 Government schemes to promote use of renewable energy sources 1.6 Introduction to energy audit	04	06
2	**Solar Energy:** 2.1 Introduction to solar energy 2.2 Physical principles of conversion of solar radiation into heat 2.3 Flat plate collectors & concentric collectors 2.4 Solar cell, Photovoltaic cell. 2.5 Solar energy storage system 2.6 Merit and de-merit of solar energy. 2.5 Applications of solar energy in Water heating, Space heating & cooling, Greenhouses	06	10
3	**Wind energy:** 3.1 Basic principles of wind energy conversion 3.2 Site selection considerations 3.3 Basic components of a wind energy conversion system (WECS). 3.4 Advantages & disadvantages of WECS. 3.5 Applications of Wind energy.	04	08
4	**Tidal Energy** 4.1 Introduction of Tidal energy 4.2 Methods of Tidal thermal electric power generation 4.3 Open cycle & closed cycle Tidal thermal energy conversion system 4.4 Basic principle of tidal power	04	06

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5	**Bio mass Energy & Bio Gas Energy:** 5.1 Introduction to biomass energy 5.2 Biomass energy resources 5.3 Biomass conversion process : Direct combustion, thermo chemical conversion, bio chemical conversion 5.4 Introduction to bio gas plant 5.5 Introduction to Bio Diesel, Bio Mass plant 5.6 Differentiate between Bio-gas and bio-mass energy. 5.7Government schemes to promote use of biomass energy	06	10

Section-II (40 Marks)

Topic No	Contents	Hrs.	Marks
6	**Emerging Energy Technologies** 6.1 Hydrogen Energy: 6.2 Properties of hydrogen 6.3 Hydrogen a as source of renewable energy 6.4 Sources of hydrogen 6.5 Production of hydrogen 6.6 Storage and transportation 6.7 Introduction to Carbon Capture and Storage (CCS) 6.8 Applications	05	08
7	**Geothermal Energy:** 7.1 Introduction 7.2 Estimates of Geothermal Power 7.3 Nature of Geothermal Fields 7.4 Geothermal Sources	03	06
8	**Chemical Energy Sources:** 8.1 Introduction 8.2 Fuel Cells • Introduction • Principle of Operation of a Fuel Cell • Classification of Fuel Cells	09	14

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	• Types of Fuel Cells 8.3 Batteries • Introduction • Basic Battery Theory • Definitions of Fundamental Quantities • Battery Fundamental Characteristics • Different Types of Battery Arrangement • Classification of Batteries • Advantages of Batteries for Bulk Energy Storage		
9	**Additional Non-Conventional Energy Sources:** 9.1 Introduction 9.2 Principles of (Magneto hydro-dynamic)MHD Power Generation 9.3 MHD Systems • Introduction • Open-Cycle Systems • Closed-Cycle Systems	05	08
10	**Thermionic Generation** 10.1 Introduction 10.2 Thermionic Emission and Work Function 10.3 Basic Thermionic Generator 10.4 Applications	02	04

Contents: Laboratory Work

SN	List of practical	Hours
1	Group discussion on green house concept	02
2.	Report on demonstration of solar water heater	04
3.	Report on demonstration of solar light with the connection diagram of solar light	04
4.	Visit to the wind power plant/ solar power plant write a report on same	08
5.	Report on demonstration of Bio mass gasifier	04

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6.	Case study of Bio gas plant and tidal power plant	06
7.	Seminar on Emerging Energy Technologies and their future scope	02
8	Collect the information of nuclear energy & nuclear thermal power plant by using website	02
	Total	**32**

Laboratory work and Term work :

Mini project:

The mini projects are to be distributed in group of 4-6 students. The student will collect the information by market research. The assessment is based on presentation and project report. Each student should submit the Mini-Project report of the assigned topic and also two page report of the topics presented by others.

The topics of Mini projects :

Students will make the survey of various solar products available in the market & will write detailed report with all specifications, applications & cost & also will draw the related sketches of the products.

Text Books:

Sr.No	Author	Title	Publication
01	Bansal Keemann, Meliss,"	Renewable energy sourcesand conversion technology",	Tata Mc Graw Hill
02	Kothari D.P	Renewable energy resources and merging technologies	Prentice Hall of India Pvt. Ltd.

Reference Books:

Sr.No	Author	Title	Publication
01	Rai G.D,	"Non-Conventional energy Sources	Khanna Publishers.
02	Ashok V. Desai	Nonconventional Energy	New Age International Publishers Ltd.

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