

**BRANCH NAME – MECHANICAL ENGINEERING**

**SEMESTER – V**

Sr. No.	Subject Code	Subject Name	Effective Teaching			Credit	Evaluation Scheme		
			L	T	P		Internal Assessment	External Assessment	Total Marks
			Hours/week						
<b>THEORY</b>									
<b>1</b>	MUPME-501N	Dynamics of Machine	5	-	-	6	40	80	120
<b>2</b>	MUPME-502N	Machine Design	5	-	-	6	40	80	120
<b>3</b>	MUPME-503N	Production Management	4	-	-	6	40	80	120
<b>4</b>	MUPME-504N	CNC Machines & Automation	5	-	-	3	40	80	120
<b>5</b>	MUPME-505N	Maintenance Engineering	5	-		3	40	80	120
<b>PRACTICAL/PROJECT</b>									
<b>6</b>	MUPME-554N	CNC Machines & Automation	-	-	4	3	40	50	90
<b>7</b>	MUPME -555N	Maintenance Engineering	-	-	4	2	20	40	60
<b>8</b>	MUPME-556N	Industrial Training	-	-	2	2	50	150	200
<b>9</b>	MUPGP-551N	General Proficiency	-	-	1	1	25	-	25
<b>10</b>	MUPGP-552N	Industrial Exposure (Assessment at University Level)	-	-	1	1	25	-	25
		<b>TOTAL</b>	<b>24</b>		<b>12</b>	<b>33</b>	<b>360</b>	<b>640</b>	<b>1000</b>

**NOTE:- Industrial Training of 30 days done after 4<sup>th</sup> semester would be evaluated in 5<sup>th</sup> Semester through Report and Viva Voice.**

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**FIFTH SEMESTER  
MECHANICAL ENGINEERING**



# MOTHERHOODUNIVERSITY

Roorkee-Dehradun Road, Village Karoundi Post Bhagwanpur, Tehsil-Roorkee, Uttarakhand, India

<b>MUPME-501N</b>	<b>Dynamics of Machine</b>	<b>L:5:T:0:P:0</b>	<b>6 Credits</b>
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## Course Objectives:

- To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
- Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.
- Develop understanding of vibrations and its significance on engineering design.
- Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

## Course Outcomes:

<b>At the end of the course ,students will be able to:</b>		<b>Bloom s Level</b>
<b>CO1</b>	To identify and enumerate different link based mechanisms with basic understanding of motion	<b>K</b>
<b>CO2</b>	Explain the working of important machine elements like clutches, brakes, flywheels, governors	<b>K</b>
<b>CO3</b>	Ability to analyze the force analysis and power calculations of brakes and dynamometer	<b>K</b>
<b>CO4</b>	To design and evaluate the performance of different cams and followers.	<b>K</b>
<b>CO5</b>	Analyze the theory involved in balancing of rotating and reciprocating members	<b>K</b>

K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6- Create

## **RATIONALE**

Diploma holder in Mechanical Engineering comes across many machines. He must have the knowledge of various mechanisms, power transmission devices, balancing of masses, vibrations etc. Hence this subject is offered.

## **DETAILED CONTENTS**

### **1. Basic Concepts**

- Definition of statics, dynamics, kinetics, and kinematics
- Rigid body and resistant body.
- Links, its classification, Kinematics chain and their types
- Kinematics pairs and its classification.
- Mechanism. Machine, Structure & Inversion
- Degree of freedom, Types of joints
- Constrained motion, and its classification.
- Classification of mechanisms.
- Four bar chain and its inversion
- Single slider crank chain and its inversions.

### **2. Fly Wheel**

Turning moment diagram plotting and its purpose  
Turning moment diagram for single cylinder single acting steam engine  
Fluctuation of energy & fluctuation of speed of Flywheel  
Applications of fly wheel. Types of fly wheels. Mass and size calculations in different case

### **3. Governors**

Functions of governor

Classification of governors - elementary knowledge of porter governor, Watt governor, Porter governor, Porter governor

Terminology used in governors

Governor effort and power, Hunting, isochronism, stability, sensitiveness of a governor Simple problems related to watt, porter and propel governor. Applications of governor

#### **4. Cams**

Definition of cam

Classification of cams

Followers and their classification

Applications of cam

Basic definition related to cams

Construction of displacement diagram of follower performing uniform velocity.

Construction of displacement diagram of follower performing SHM

Construction of displacement diagram of follower performing uniform acceleration and deceleration

Simple cam profile for uniform velocity, SHM and uniform acceleration and deceleration

#### **5. Power Transmission Devices (Belt, Rope and Chain Drive)**

Introduction.

Belt, Rope and Chain drives

Material for Belt, and Rope

Open and crossed belt drives, action of belt on pulleys, velocity ratio.

Slip and Creep in belts,

Length of belt in case of open and cross belt

Ratio of tensions in case of flat and V belt

Power transmitted and maximum power transmitted by belt

Centrifugal force and its effect on belt tension

Initial tension and its effect on the transmission of maximum

Simple problems on power transmitted by belts and ropes

## **6. Gear Drive**

Functions of gear

Classification of gears and Gear material

Gear nomenclature

Simple, compound, reverted and epicyclical gear train

Horse power transmitted by a gear train

Selection of gear trains- simple and epicyclical

## **7. Brakes and Dynamometers**

Introduction and Classification of brakes

Brief description of different types of Mechanical Brake such as block or shoe brake Simple and Differential band brake.

Definition and types of dynamometers, prony brake dynamometer, rope brake dynamometers, hydraulic dynamometer, belt transmission dynamometer.

## **8. Clutches**

Function of clutch

Classification of clutches

Principle of working of Single Disc clutch and Cone clutch with simple linediagram

Principle of working of Multi plate clutch and Centrifugal clutc

## **9. Balancing**

Need of balancing

Concept of static and dynamic balancing

Forces due to revolving masses

Balancing of single rotating mass by single mass in the same plane

Balancing of single rotating mass by two masses in the different plane

Concept of reference plane

Balancing of several masses rotating in same plane

Balancing of several masses rotating in different planes

## **INSTRUCTIONAL STRATEGY**

1. Use teaching aids for classroom teaching.
2. Give assignments for solving numerical problems.
3. Arrange industry visits to augment explaining use of various machine components like belt, rope, chain, gear drives, action due to unbalanced masses, brake clutch, governors, fly wheels, cams and gear drives.
4. Video films may be used to explain the working of mechanisms and machine components like clutch, governors, brake etc.

## **RECOMMENDED BOOKS**

1. Mechanism and Machine Theory; JS Rao and Dukkupati; Wiley Eastern, New Delhi.
2. Theory of Mechanism and Machine; A Ghosh and AK Malik, East West Press (Pvt.) Ltd., New Delhi.
3. Theory of Machines; SS Rattan: Tata McGraw Hill, New Delhi.
4. Theory of Machines by RS Khurmi; S; S; S; S; S and JK Gupta; S. Chand and Company Ltd., New Delhi.
5. Theory of Machines and Mechanisms by PL Ballaney; Khanna Publishers, New Delhi.

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# MOTHERHOODUNIVERSITY

Roorkee-Dehradun Road, Village Karoundi Post Bhagwanpur, Tehsil-Roorkee, Uttrakhand, India

<b>MUPME-502N</b>	<b>Machine Design</b>	<b>L:5:T:0:P:0</b>	<b>6 Credits</b>
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## Course Objectives:

1. Enable students to attain the basic knowledge required to understand, analyze, design and select machine elements required in transmission systems.
2. Reinforce the philosophy that real engineering design problems are open-ended and challenging
3. Impart design skills to the students to apply these skills for the problems in real life industrial applications

## Course Outcomes:

<b>At the end of the course ,students will be able to:</b>		<b>Blooms Level</b>
<b>CO1</b>	Understand the design procedure and selection of material for a specific application.	<b>K</b>
<b>CO2</b>	Analyze machine components subjected to static and variable loads.	<b>K</b>
<b>CO3</b>	To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.	<b>K</b>
<b>CO4</b>	Understand the basic concept of shafts and joints	<b>K</b>
<b>CO5</b>	Design of Flange Coupling	<b>K</b>

K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5-Evaluate, K6- Create

## **RATIONALE**

This course is designed for the diploma level students for Mechanical and Automobile engineering as first course in Machine Design. The contents of this subject are organized to understand the intricacies of different engineering design aspects. This will also help the students to enhance their imagination, innovative skill, adaptability to new situation and continued learning skills for problem solving

## **DETAILED CONTENTS**

### **1. Introduction**

Design – Definition, Type of design, necessity of design Comparison of designed and undersigned work Design Procedure Practical examples related with design procedure Characteristics of a good designer Characteristics of environment required for a designer Design terminology: stress, strain, factor of safety, factors affecting factor of safety, stress concentration, methods to reduce stress concentration, fatigue, endurance limit. General design considerations Engineering materials and their mechanical properties: Properties of engineering materials: elasticity, plasticity, malleability, ductility, toughness, hardness and resilience. Fatigue, creep, tenacity, strength.

### **2. Design Failure for static loading**

Brittle and ductile behavior of the materials, Various design failures under static loading, causes of failure

1. Maximum principal stress theory.
2. Maximum shear stress theory
3. Distortion Energy theory

Design for tensile, compressive and torsional loading

Design for combined torsion and bending

### **3. Design Equation for Impact loading**

Examples of impact loading, stress and deflection due to impact load, selection of impact factor for minor, medium and heavy shock load

### **4. Design for Cyclic loading**

Types of cyclic loading, failure of parts due to cyclic loading, design strength for cyclic loading, design equation for simple cyclic loading

### **5. Design of Shaft**

Type of shaft, shaft materials, Type of loading on shaft, standard sizes of shaft available

Design of shaft subjected to torsion on the basis of:

- Strength criterion
- Rigidity criterion

Design of shaft subjected to bending

Design of shaft subjected to combined torsion and bending

### **6. Design of Key**

Types of key, materials of key, functions of key

Failure of key (by Shearing and Crushing).

Design of key (Determination of key dimension)

Effect of keyway on shaft strength. (Figures and problems).

## 7. Design of Joints

Types of joints - Temporary and Permanent, utility of joints  
Temporary

Joint:

7.1.1 Knuckle Joints – Different parts of the joint, material used for the joint, type of knuckle Joint, design of the knuckle joint. (Figures and problems). Permanent Joint: Welding symbols, standards and materials having high weld ability. Welded Joint - Type of welded joint, strength of parallel and transverse fillet welds. Strength of combined parallel and transverse weld. Axially loaded welded joints. Riveted Joints.: Rivet materials, Rivet heads, leak proofing of riveted joint – caulking and fullering. Different modes of rivet joint failure. Design of riveted joint – Lap and butt, single and multi-riveted joint

## 8. Design of Flange Coupling

Necessity of a coupling, advantages of a coupling, types of couplings, design of flange coupling. (both protected type and unprotected type) loads.

## INSTRUCTIONAL STRATEGY

- Use models of machine parts/components.
- Presentation should be arranged for various topics.

## REFERENCE BOOKS

- (i) Machine Design- Fundamentals and Practices, by P C Gope, PHI Learning Pvt Limited, New Delhi. 2012
- (ii) Machine Design by R.S. Khurmi and JK Gupta; Eurasia Publishing House (Pvt.) Limited, New Delhi.
- (iii) Machine Design by Sharma and Agrawal; Katson Publishing House, Ludhiana.



# MOTHERHOODUNIVERSITY

Roorkee-Dehradun Road, Village Karoundi Post Bhagwanpur, Tehsil-Roorkee, Uttarakhand, India

<b>MUPME-503N</b>	<b>Production Management</b>	<b>L:4:T:0:P:0</b>	<b>6Credits</b>
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## Course Objectives:

- Understand the various production and operations design decisions and how they relate to the overall strategies of organizations.
- Understand the importance of product and service design decisions and its impact other design decisions and operations.
- To understand techniques of location and facility planning; line balancing; job designing; and capacity planning in operations management.

## Course Outcomes:

<b>At the end of the course ,students will be able to:</b>		<b>Blooms Level</b>
<b>CO1</b>	Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.	<b>K</b>
<b>CO2</b>	Develop an ability to perform the role of a materials manager in an organization.	<b>K</b>
<b>CO3</b>	Study the different work study methods	<b>K</b>
<b>CO4</b>	Recognize the objectives, functions, applications of PPC and forecasting techniques.	<b>K</b>
<b>CO5</b>	Student will demonstrate Commitment to quality, timeliness, and continuous improvement in production rate in manufacturing sector	<b>K</b>

K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaulate, K6- Create

## **Rationale**

After studying the subject of production management, the students will be able to know the basics of production planning and control, industrial engineering, and estimation and costing. This will enable them to understand and handle production environment effectively.

### **1. Introduction**

Production management defined, history of development, functions of PM, scope & applications of PM, advantages- disadvantages.

### **2. Production and Productivity**

Production, production functions, productivity, factors affecting productivity, measurement of productivity, causes of decrease in productivity, difference between production and productivity.

### **3. Plant Location, Layout and Material Handling**

Plant location, factors affecting plant location, concept of plant layout, types of layout, their characteristics, factors affecting plant layout, work station design, factors considered while designing a work station, introduction, need and objective of material handling, factors considered while selecting a material handling device, safety concept of material handling equipment

### **4. Work Study**

Definition and scope of work study; areas of application of work study in industry, Role of work study in improving productivity, Objectives, needs and methods of method study, information collection, recording techniques, process symbols, charts and diagrams, critical examination, development, installation and maintenance of improved methods, work measurement objectives,

needs and methods of work measurement, time study, various allowances, calculation of time, work sampling, standard data and its use. Application of engineered time standards and work sampling, Ergonomics, concept and advantages.

## **5. Production Planning and Control**

Introduction, objectives and components (functions) of P.P.C,

Advantages of production planning and Production Control, stages of P.P.C, process planning,

routing, scheduling, dispatching and follow up, routing purpose, route sheets, scheduling – purpose, machine loading chart, Gantt chart, dispatching – purpose, and procedure, follow up – purpose and procedure. Production Control in job order, batch type and continuous type of productions. Difference between these controls.

## **6. Inspection and Quality Control**

Definitions, types of inspection and procedure, Quality, Quality control, Statistical quality control, Process capability, Control charts for variables - X and R chart, control chart, for fraction defectives (P chart), control chart for number of defects (C chart), Concept of ISO 9000, ISO 14000 and TQM, Quality Circles.

## **7. Estimation and Costing**

Introduction, purpose/functions of estimating, costing concept, ladder and elements of cost, difference between estimation and costing. Over heads and their types, estimation of material cost, estimation of cost for machining processes, numerical problems.

## **INSTRUCTIONAL STRATEGY**

Teacher should put emphasis on giving practical problems related to plant location and plant layout. Students should be taken to industrial units to give an exposure of production environment, plant layout and material handling. Live problems may be given to students to carry out case studies in teams under the guidance of teacher.

## **RECOMMENDED BOOKS**

1. Industrial Engineering by O.P. Khanna; Dhanpath Rai and Sons, New Delhi.
2. Industrial Engineering by S.C. Sharma; Khanna Publisher.
3. Industrial Engineering and Management by T.R. Banga.
4. Elements of work study by Suresh Dalela.
5. Production Management by Jain and Aggarwal.





# MOTHERHOODUNIVERSITY

Roorkee-Dehradun Road, Village Karoundi Post Bhagwanpur, Tehsil-Roorkee, Uttarakhand, India

<b>MUPME-504N</b>	<b>CNC Machines &amp; Automation</b>	<b>L:5:T:0::0</b>	<b>3 Credits</b>
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## Course Objectives:

- To impart knowledge on the fundamentals of numerical control, tools, cutting parameters and work holding devices of CNC machine tools
- To familiarize with CNC part programs for turning and machining centers for given components
- To develop the skill to perform verification tests on CNC machines

## Course Outcomes:

<b>At the end of the course ,students will be able to:</b>		<b>Blooms Level</b>
<b>CO1</b>	To introduce the basic automation, CNC machine and part programing	<b>K</b>
<b>CO2</b>	Classify and distinguish NC, CNC and DNC systems.	<b>K</b>
<b>CO3</b>	Create manual and APT part programs for complex profiles for Lath and milling machine	<b>K</b>
<b>CO4</b>	Explain CNC machine structures and system drives	<b>K</b>
<b>CO5</b>	Recognize use of robotics, in the field of manufacturing	<b>K</b>

K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaulate, K6- Create

## **Rationale**

Computer-aided manufacturing is the use of computer software to control machine tools and related machinery in the manufacturing of work pieces. NC and CAM may also refer to the use of a computer to assist in all operations of a manufacturing plant, including planning, management, transportation and storage.

**Course objective:** Its primary purpose is to create a faster production process and components and tooling with more precise dimensions and material consistency, which in some cases, uses only the required amount of raw material (thus minimizing waste), while simultaneously reducing energy consumption.

### **1. Automation**

Introduction to CAM, Automated Manufacturing system, Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends.

### **2. Introduction of NC Machines-**

Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Axis orientation system of NC Machines. Advantages, suitability and limitations of NC machine tools, Application of NC system, DNC & BTR (behind tape reader), BINARY NUMBER SYSTEM (ADDITION & SUBTRACTION)

### **3. NC Part Programming & Common Problems in CNC Machines**

Part programming and basic concepts of part programming, NC words, part programming formats, simple programming for rotational components, Common problems in mechanical, electrical, pneumatic, electronic and PC components of CNC machines.

#### **4. System Devices**

Introduction to DC motors, stepping motors, slide ways, pallets, tool magazines, sward removal system.

#### **5. Control of NC Systems**

Open and closed loops, Control of point to point systems, Incremental open loop control, Incremental close loop, Absolute close loop, Control loop in contouring systems, Adaptive control and its types.

#### **6. Computer Integrated Manufacturing system**

Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process Planning-Retrieval and Generative, Computer aided Inspection.

#### **7. Robotics and Intelligent Manufacturing**

Types and generations of Robots, Structure and operation of Robot, Robot applications, Economics, Robot programming methods.

Introduction to Artificial Intelligence for Intelligent mooring.

#### **List of Practical**

- 1 To study the basic feature and operation of NC, CNC machine & Study the constructional details of CNC lathe, working of following, tool changer and tool setter, Multiple pallets, Safety devices.
- 2 To demonstrate how to program (using the computer-assisted method) and machine a simple part on the CNC lathe and Develop part programs for following lathe operations:
  - Plain turning and facing operations
  - Taper turning operations (internal and external)

- Thread cutting operations (internal and external)

3 To operate a CNC milling machine and become familiar with set-up, procedures and data flow.

4 To use AutoCAD to define a series of closed 2-D polygons that form initials, or other artistic creations, within a 150 x 100 mm border. To run the output data file through the Auto LISP program called "digitize.lsp".

5 To study the basic feature and operation of NC, CNC machine & Study the constructional details of CNC lathe, working of following, tool changer and tool setter, Multiple pallets, Safety devices.

6 To demonstrate how to program (using the computer-assisted method) and machine a simple part on the CNC lathe and Develop part programs for following lathe operations:

- Plain turning and facing operations
- Taper turning operations (internal and external)
- Thread cutting operations (internal and external)

7 To operate a CNC milling machine and become familiar with set-up, procedures and data flow.

8 To use AutoCAD to define a series of closed 2-D polygons that form initials, or other artistic creations, within a 150 x 100 mm border. To run the output data file through the Auto LISP program called "digitize.lsp".

**Text Books:**

1. Numerical Control and Computer aided Manufacturing, By, Kundra, Rao and Tiwari.
2. Automation, Production Systems and Computer Integrated Manufacturing by Mikel P. Grover.
3. Computer Aided Manufacturing by Kundra and Rao.
4. Computer control of manufacturing systems by Koran.

**Reference Books:**

1. Numerical Control Machine Tool by Y. Koren and Joseph Ben Uri.
2. Computer Aided Design and Manufacture by Groover and Zimmer, PHI.
3. Technology of Computer aided Design and Manufacturing by Kumar and Jha, Dhanpath Rai and Sons
4. CNC Machines –Programming and Applications by M Adithan and BS Pablo, New Age International (P) Ltd., Delhi.
5. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
6. Numerical Control of Machines Tools by Yurem Koren and IB Uri, Khanna Publishers, New Delhi.

**INSTRUCTIONAL STRATEGY**

This is a highly practice-based course. Efforts should be made to develop programming skills amongst the students. During practice work, it should be ensured that students get opportunity to individually perform practical tasks.



# MOTHERHOODUNIVERSITY

Roorkee-Dehradun Road, Village Karoundi Post Bhagwanpur, Tehsil-Roorkee, Uttarakhand, India

<b>MUPME- 505N</b>	<b>Maintenance Engineering</b>	<b>L:5:T:0:P:0</b>	<b>3Credits</b>
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## Course Objectives:

- Explain the purpose and principles of maintenance
- Describe the main organisational setups for maintenance
- Describe the different strategies used in carrying out the maintenance activity
- To prevent or reduce the likelihood or frequency of failures of engineering components and systems

## Course Outcomes:

<b>At the end of the course ,students will be able to:</b>		<b>Blooms Level</b>
<b>CO1</b>	Understand the principles and objectives of Maintenance Engineering.	<b>K</b>
<b>CO2</b>	Describe the various categories of maintenance.	<b>K</b>
<b>CO3</b>	Summarize the various processes involved in machine testing and its lubrication	<b>K</b>
<b>CO4</b>	Explain the repair methods of beds and slide ways.	<b>K</b>
<b>CO5</b>	Discuss various repair and maintenance technique.	<b>K</b>

K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaulate, K6- Create

## **RATIONALE**

A diploma engineer comes across installation, maintenance, testing of various machines and equipment in industries. The layout of different machines, their foundation is an important phenomenon of an industry. He should know the various methods of testing and maintenance. This subject will enable diploma holders to deal with such aspects.

## **DETAILED CONTENTS**

### **1. Introduction**

Necessity and advantages of testing, repair and maintenance

Economic aspects, manpower planning and materials management

Fits and tolerances – common fits and tolerances used for various machineParts

### **2. Erection and Commissioning of Machines (Installation)**

Location, layout and positioning of machines

Foundation – types of foundation, foundation plan, erection and leveling, grouting, vibration damping, vibration isolation – methods of isolation, anti-vibration mounts.

### **3. Testing of Machines**

Testing equipment – dial gauge, mandrel, spirit level, straight edge, autocollimator

Testing methods – geometrical/alignment test, performance test, testing under load, run test, vibrations, noise

#### **4. Lubrication Systems**

Lubrication methods and periodical lubrication chart for various machines (daily, weekly, monthly )

Handling and storage of lubricants

Lubricants conditioning and disposal

Lubricant needed for specific components such as gears, bearings, and chains

Purpose and procedure of changing oil periodically (like gear box oil)

#### **5. Repairing**

Common parts which are prone to failure, reasons of failure

Repair schedule

Parts that commonly need repair such as belts, couplings, nuts, and bolts

#### **6. Maintenance**

Definition, advantages, limitations and types of maintenance viz. preventive, breakdown, predictive Organization of maintenance Introduction to computerized maintenance record ISO standards for maintenance documentation Introduction to machine history card – purpose and advantages Preparation of yearly plan for preventive maintenance Need of frequently needed spare parts inventory



## **LIST OF PRACTICALS**

1. Preparation of prevention maintenance check.
2. Condition monitoring by nondestructive testing.
3. Case study on trouble free maintenance.
4. Project on maintenance of utility equipment like compressors, pumps, driers, valves (actuator type valves).
5. Equipment/machine leveling and alignment.
6. Maintenance of material handling equipment – pulley blocks, hand operated cranes, fork lifts, hydraulic jacks, mobile cranes, winches.
7. Use of lubrication equipment like oil gun, grease gun.
8. Removing old lubricant, cleaning and replenishing the machine with fresh lubricant.
9. Case study on computerized maintenance schedule.
10. Reconditioning of machine parts.
11. Replacing gear.
12. Replacing bearings (all types).
13. Practically making different types of fits.

## **INSTRUCTIONAL STRATEGY**

1. Lay greater emphasis on practical aspects of maintenance.
2. Make use of transparencies, video films and CD's.
3. Expose the students to real life situation.
4. Promote continued learning through properly planned assignments.
5. Demonstrate sample of all types of gear and bearings.

## **RECOMMENDED BOOKS:**

1. Industrial Maintenance by HP Garg; S. Chand and Company, Delhi.
2. Plant Maintenance Engineering by RK Jain; Khanna Publishers, Delhi.
3. Installation, Servicing and Maintenance by SN Bhattacharya; S Chand and Company, Delhi.
4. Maintenance Engineering and Management by RC Mishra and K Pathak; Prentice Hall of India Pvt. Ltd., New Delhi.