

PLANT MAINTENANCE ENGINEERING

L T P
3 0 0

Curri.Ref.No:ME 507

Total Contact hrs.: 45

Total marks: 100

Theory:

End Term Exam: 70

Theory: 45

P.A.: 30

Tutorial: 0

Practical:

Practical: 0

End Term Exam: 0

Prerequisite:

PA: 0

Total Credit: 3

Rationale :

Maintenance is an important and integral part of a manufacturing organization. Maintenance means up-keeping of the equipment to ensure their reliability, accuracy, durability and availability of equipment needed to achieve desired production target. It is necessary to keep machinery, buildings and equipment in good operating conditions all the time. No definite all purpose maintenance procedure can be recommended or prescribed in general. It varies from plant to plant, depending on the size, technology and prevailing condition of an individual concern. Technicians working on any type of concern should be acquainted with the basic principles of maintenance.

Aim

The students will be exposed to installation and maintenance of different types of machinery, and the common tools and materials required for these activities.

UNIT	TOPIC/SUB TOPIC	Contact Hrs.
1.0	INTRODUCTION	2
1.1	Definition and objectives of maintenance	
1.2	Fits and Tolerance – types of fits, tolerance, symbol of fits, guide for selection of fits	
1.3	Tools and equipment for installation and maintenance work.	
2.0	GENERAL INSTALLATION PROCEDURE OF A STRUCTURE OR MACHINE	4
2.1	Location, layout and positioning of machine	
2.2	Foundation: dynamic and static loads, ground condition, vibration consideration, foundation bolts, excavation, template, concrete mixing, pouring, levelling and alignment.	
2.3	Grouting, fitting of parts and fittings, final levelling and test runs.	
3.0	POWER TRANSMISSION DEVICES	6
3.1	Key and keyway – dismantling of keyed joint, assembly of keyed joints.	
3.2	Plain bearing – assembly of plain bearings, bush repairing.	
3.4	Coupling – Assembly of couplings, coupling defects and repair.	
3.5	Clutches – defects and repair	
3.6	Belt drives – belt joining methods, installation, maintenance	
3.7	Chain drive – defects and repair of chain, erection of chain and sprocket drive.	
3.8	Gears – Assembly of gears, gear tooth failure, maintenance, gear inspection, errors	
4.0	SEALS, PACKING AND GASKETS	3
4.1	Types of seals – static seal (gasket), dynamic seals, labyrinth seals, packings.	
4.2	Application – seals in bearing, packing and seals for pumps, seals and packing for steam turbine, packings in pipe fittings.	
5.0	LUBRICATION	3
5.1	Functions of lubrication.	
5.2	Properties of lubricants and selection of lubricant.	
5.3	Modes of lubrication – boundary, fluid film, mixed.	
5.4	Types of lubricating systems – hand, dip, wick, splash, forced circulating	

5.5	Lubricating instructions.	
6.0	PUMPS AND AIR COMPRESSORS	7
6.1	Installation of pump – foundation, grouting, alignment, fittings.	
6.2	Maintenance of pump components – wearing ring, shaft sleeve, packing, bearing.	
6.3	Troubles and their cures in centrifugal pump.	
6.4	Reciprocating pump – installation, caution on operating the pump.	
6.5	Air compressors – selection, installation.	
6.6	Routine overhaul of air compressor	
6.7	Maintenance schedule of reciprocating air compressor.	
7.0	MAINTENANCE OF PIPE LINES AND PIPE FITTINGS	4
7.1	Pipes – uses, materials of pipe, pipefittings, pipe supports.	
7.2	Procedure of pipeline installation.	
7.3	Major causes of faults and their repairing. - Leakage, swaying of pipes, water hammer, corrosion.	
7.4	Steam piping – fittings, pipe joints, pipe welding, expansion bends.	
8.0	INDUSTRIAL FANS / BLOWERS	3
8.1	Installation procedure of fans	
8.2	Maintenance of fans – problems and remedies with fan: high temperature, corrosion, abrasion, fan noise; fan balancing.	
8.3	Positioning of fans.	
8.4	Dust collecting equipment – maintenance	
9.0	ELECTRIC MOTORS	3
9.1	Types of motors – A. C. motors, D. C. motors.	
9.2	Selection and installation of motors.	
9.3	Maintenance of motor – bearing, slip rings and brushes and commutator.	
10.0	INTERNAL COMBUSTION ENGINE	5
10.1	Diesel engine – foundation, erection.	
10.2	Maintenance of main parts of diesel engine - cylinder head, cylinder block and cylinder liner, piston and piston ring, crank shaft and main bearing, fuel oil injector.	
10.3	Operational troubles of a diesel engine.	
10.4	Maintenance of petrol engine parts.	
10.5	Trouble shooting of a petrol engine.	
11.0	MAINTENANCE PLANNING	5
11.1	Definition, advantage and limitation of types of Maintenance - scheduled, predictive, preventive, breakdown.	
11.2	General organization of maintenance.	
11.3	Maintenance planning – planning and scheduling of maintenance; equipment history card, master schedule card, work report; controlling; maintenance and reliability.	
11.4	Spare parts management – spare parts planning; codification of spares, preservation of past data, practice to use standard spares, effective purchase procedures; classification of spare parts	
	Total Hrs	45

RECOMMENDED BOOKS

1. H. P. Garg : *Industrial Maintenance* - S. Chand & Company Ltd.
2. R. K. Jain : *Plant Maintenance Engineering*
3. Nayak : *Maintenance Engineering*
4. A.R. Basu, P G Goswami, T. P. Mukherjee : *Installation Maintenance Servicing* – M. Dutta & Co., Calcutta
5. S. N. Bhattacharyya : *Installation Servicing and Maintenance* – S. Chand & Company Ltd.
6. L.S. Srinath: *Introduction to Reliability Engineering* - East West Publication

REFRIGERATION AND AIR CONDITIONING

L T P
3 0 2

Curri. Ref. No: ME 509

Total Contact hrs.: 75

Total marks: 125

Theory:

Theory: 45

End Term Exam: 70

Tutorial: 0

P.A.: 30

Practical: 30

Practical:

Prerequisite: ME401, ME402

End Term Exam:

P.A: 25

Total Credit: 4

Rationale:

Refrigeration is the process of cooling below surrounding temperature. It has numerous applications spanning from air conditioning to industrial refrigeration for chemical, pharmaceutical, petrochemical plants, including food preservation and many special applications in manufacturing and construction industries.

Air-conditioning does not necessarily mean cooling only. It means treatment and supply of air after controlling its temperatures, humidity and cleanliness for human comfort.

The field of application for Refrigeration and Air conditioning is growing rapidly. But with the steady increase in energy cost and the threat perception of diminishing reserves of conventional fuel, the subject of Refrigeration & Air Conditioning becomes more specialized and energy effective day by day. Therefore, the students who would like to pursue their industrial career in this widening field, should undertake this electric course.

Aim

After study of this subject a diploma mechanical engineer should have a clear understanding about the diverse field of application of Refrigeration & Air Conditioning, and sufficient knowledge about the equipment used and the processes involved in their operation.

UNIT	TOPIC/SUB-TOPIC	Contact Hrs.
1.0	APPLICATIONS OF REFRIGERATION & AIR CONDITIONING	4
1.1	Definitions and relationship of "Refrigeration" and "Air-conditioning"	
1.2	Major uses of Air-conditioning: buildings, industrial air conditioning, ventilation, room air conditioners, vehicle	
1.3	Major uses of refrigeration: cold storage, food preservation, and distribution, food processing, chemical processes, desalting of sea-water, special applications.	
2.0	THERMAL PRINCIPLES	3
2.1	Definition and concept of: enthalpy, heat transfer by conduction, convection and radiation, heat exchangers, evaporation.	
3.0	VAPOUR COMPRESSION SYSTEM	10
3.1	Concept of vapour compression system; flow diagram and pressure - enthalpy diagram; Co-efficient of performance (COP);	
3.2	Use working principle and constructional features of component equipment: compressors, condensers of evaporators (water cooled, air-cooled), expansion valve (thermostatic and electric).	
3.3	Classification and nomenclature of refrigerants; properties of common refrigerants.	
4.0	VAPOUR ABSORPTION SYSTEM	4
4.1	Principle of absorption system; the absorption cycle; comparison between absorption and compression system.	
5.0	PSYCHROMETRY	4
5.1	Dalton's law of partial pressures, dry air, moist air, saturated air, degree of saturation, humidity, absolute humidity, relative humidity, dry bulb temperature, wet bulb temperature,	

	wet bulb depression, dew point temperature, dew point depression, wet bulb thermometer, sling psychrometer, adiabatic saturation temperature.	
5.2	Psychrometric chart: dry bulb temperature lines, specific humidity or moisture content lines, dew point temperature lines, wet bulb temperature lines, enthalpy (total heat) lines, specific volume lines, relative humidity lines.	
5.3	Psychrometric processes: sensible cooling or heating, humidification and dehumidification, adiabatic mixing of two streams, chemical dehumidification, adiabatic evaporative cooling.	
6.0	COMFORT CONDITIONS & LOAD CALCULATIONS	6
6.1	Factors governing human comfort; comfort standard, related to temperature, humidity, humidity ratio, air velocity and ventilation (air change).	
6.2	Cooling load calculations: room load, heating load estimates, transmission heat loss, solar radiation, internal heat gains.	
7.0	AIR CONDITIONING SYSTEMS	14
7.1	Concept of an air-conditioning system; single zone system; outdoor air control; multiple zone system.	
7.2	Air distribution system; duct size design, centrifugal fan (blown) and their characteristics.	
7.3	Water heaters; room heaters (water and electric); water and refrigerant piping.	
7.4	Constructional details and working of a room air conditioner; cooling coil; desert cooler.	
7.5	Air-conditioning controls; various control systems, function of various control components like: two way and three way valves, ampers, pressure regulators, thermostats, humidistates etc.	
7.6	Concept of the workshop of Car air conditioning system	
8.0	PRACTICAL	30
8.1	Experimentation on water cooler test rig.	
8.2	Experimentation on ice plant test rig.	
8.3	Visit to a cold storage.	
8.4	Demonstration of domestic refrigerator in respect of construction, operation and controls used.	
8.5	Demonstration of various controls like L.P/H.P. cut outs, thermostats, overload projector, solenoid valve used in RAC.	
8.6	Identification of components of 'hermetically sealed compressor'.	
8.7	Visit to repair and maintenance workshop in view of use of various tools and charging procedure.	
8.8	Cooling load calculations for cabin, classroom, laboratory, canteen and dairy plant, milt storage, small freezers.	
8.9	Trial on AC test rig.	
8.10	Visit to central AC plant in view of ducting system, insulation system and air distribution system.	
8.11	Trouble shooting of domestic refrigerator / window air-conditioner.	

Total Hrs. 75

REFERENCE BOOKS:

1. Stoecker and Jones: *Refrigeration & Air Conditioning* – Mc graw-Hill international edition.
2. C. P. Arora : *Refrigeration and Air Conditioning* – TMH
3. Manohar Prasad : *Refrigeration and Air Conditioning* – New Age International (P) Ltd.
4. P. L. Ballaney : *Refrigeration and Air Conditioning* - Khanna Publishers.
5. R. S. Khurmi: *Refrigeration and Air Conditioning* – S. Chand & Co.
6. Arora and Domkundwar: *Refrigeration and Air Conditioning* – Dhanpat Rai & Sons.
7. P. N. Anantanarayan: *Refrigeration and Air Conditioning* – Tata Mc Graw Hill.
8. Roy Dossat: *Principles of Refrigeration* – Pearson Education.
9. K. Soman: *Thermal Engineering* – PHI Learning Pvt. Ltd.

PROJECTS

L T P
0 0 8

Curri. Ref. No: ME516

Total Contact hrs.: 120 Total marks: 150

Theory: 0

Tutorial: 0

Practical: 120

Prerequisite: Nil

Total Credit: 3

Theory:

End Term Exam: 0

P.A.: 0

Practical:

End Term Exam: 0

P.A: 150

UNIT	TOPIC/ SUB-TOPIC	Contact Hrs.
1.0	LEVELLING, ALIGNMENT AND TESTING OF ANY ONE OF THE FOLLOWING MACHINES:	12
1.1	Drilling Machine	
1.2	Centre Lathe	
1.3	Shaping Machine	
1.4	Dismantling and assembling of machine parts, study of relevant transmission of motion, power generation & mechanism.	
2.0	PROJECT JOB(FABRICATE/MANUFACTURE ONE OR MORE FROM THE FOLLOWING OR SIMILAR TYPE OF EQUIPMENT/ACCESSORIES)	60
2.1	Gear puller	
2.2	Machine vice(simple)	
2.3	Jigs and fixtures for drilling works	
2.4	Agricultural implements	
2.5	Centrifugal pump(small)	
2.6	Double acting hand pump	
2.7	Screw jack	
2.8	Hand shearing machine	
2.9	Hand blower (small)	
3.0	PROJECT TYPE JOB (PRODUCE ANY ONE FROM FOLLOWING LIST)	24
3.1	Cast iron main switch outer casing	
3.2	Cast iron base plate for vice stand	
3.3	Stepped motor pulley	
4.0	PROJECT TYPE JOB (PRODUCE ANY ONE FROM FOLLOWING LIST)	24
4.1	Window grills	
4.2	Iron door and window frame	
4.3	Steel furniture	
4.4	Iron structural fabrications	

Total Hrs 120

NOTE

The project work as indicated above will involve students to work in different shops depending on the nature of the job. All the jobs indicated above are not of the same difficulty level nor they will require the same time for completion. The number of jobs to be assigned to a student or a group of students will be decided by the teacher concerned to ensure a uniform standard as far as practicable on the basis of available facilities.

MACHINE TOOLS – II

L T P

Total Contact hrs.: 45

Theory: 45

Tutorial: 0

Prerequisite:

Total Credit: 3

Total marks: 100

Curri. Ref. No:ME502

Theory:

End Term Exam: 70

P.A.: 30

Rationale :

Metal cutting (also called Machining) is by far the most versatile and most used process for giving final shape to most of the engineering materials, to be used either as finished products or as parts for making machines, which will produce finished goods and services. All such metal cutting operations are performed by a host of machines called Machine Tools. Different types of machine tools are used for performing different machining operations for giving different shapes to machined items. No engineering production unit can be imagined without machine tools.

In other words, knowledge of constructional features & use of machine tools is of vital importance to a mechanical engineer.

Aim

After study of the subject Machine Tools (distributed over two courses viz. Machine tools I and II), a diploma mechanical engineer should have a clear conception about metal cutting process, its importance and about the constructional features, uses and operations of all basic types of machine tools normally used in industry.

UNIT	TOPIC/SUB-TOPIC	Contact Hrs.
1.0	MILLING MACHINE	8
1.1	Operations; classifications; specifications.	
1.2	Constructional features and parts of a horizontal and vertical milling machine	
2.0	BORING MACHINE	5
2.1	Horizontal and vertical boring machine; Specifications uses.	
2.2	Constructional features of horizontal and vertical boring machine.	
2.3	Boring bar; boring heads; tools for boring bar	
2.4	Various operations performed in boring machine.	
3.0	GRINDING MACHINE	8
3.1	Types of surface finishing operation	
3.2	Grinding operation; comparison with other metal cutting operations.	
3.3	Classification and specification of grinding machines (cylindrical, surface, tool & cutter, centreless).	
3.4	Constructional features of different types of grinding machines.	
3.5	Construction of grinding wheel; different abrasives and bond materials; wheel classification; different wheel shapes; wheel dressing.	
4.0	GEAR HOBBIING MACHINE	6
4.1	Generation vs. form cutting method of gear cutting.	
4.2	Constructional features and principle of operation of a hobbing machine.	
4.3	Hob cutters	
5.0	CAPSTAN & TURRET LATHE	10
5.1	Characteristic features of a capstan or turret lathe; specialised use of these machines.	

6.0 NUMERICAL CONTROL (NC) MACHINES

8

6.1 Introduction to numerical control machine: NC, CNC and DNC

6.2 Principles of numerical control; operation of NC system: point-to-point, continuous path / contour system.

6.3 Constructional details of a CNC machine: axis identification, slide ways, spindle mounting, drive units, position transducers.

6.4 Input media (punched cards, magnetic tapes, punched tape); decimal or binary coding; card, magnetic tape, punched card reader; operation procedure: planning, part programming, tape/card preparation, verification, production.

Total Hrs 45

REFERENCE BOOKS:

1. W. A.J. Chapman : *Workshop technology, Part 2 & 3* – ELBS.
2. S. K. Basu and D. K. Pal : *Design of Machine Tools* – Oxford & IBH Publishing Co. Pvt. Ltd.
3. S. K. Hajra Choudhury, S. K. Bose, A. K. Hajra Choudhury : *Elements of Workshop Technology Vol II* – Media Promoters & Publishers Pvt. Ltd.
4. B. S. Pabla and M. Adithan : *CNC Machines* – New Age International (P) Ltd.

NOTES :

1. *Students should be conversant and be able to operate all types machine tools available in the workshop of the respective institute.*
2. *Operation of the machines not available in the institute should be shown to the students using factory visits which is a mandatory part of mechanical engineering curriculum.*

MECHANICAL ESTIMATION

L T P
2 0 2

Total Contact hrs.: 60

Total marks: 125

Theory: 30

Tutorial: 0

Practical: 30

Prerequisite: G201, G202, G203, ME405

Curri. Ref. No: ME510

Theory:

End Term Exam: 70

P.A.: 30

Practical:

End Term Exam: 0

P.A: 25

Total Credit: 3

Rationale :

Estimation is the act of finding the cost, which is likely to be incurred in the manufacture of an article, before it is actually manufactured. In all organizations, before starting actual production or for making an quotation against tender, estimation is done. In big organizations this estimation is limited to estimate department. In small industrial organisations the technicians have to supervise number of activities as there are no separate department for each activity. Hence they have to make estimate frequently. Hence, every technician should study this subject.

Aim

The students should be exposed to the basic methods of calculating quantity of material, machine time and labor required for different manufacturing operations in different manufacturing shops to produce an item.

UNIT	TOPIC/SUB-TOPIC	Contact Hrs.
1.0	ESTIMATION AND COSTING	4
1.1	Estimating – definition, functions, constituents of estimate.	
1.2	Elements of cost – materials, labour, expenses	
1.3	Components of cost – prime cost, factory cost, office cost, total cost.	
1.4	Indirect expenses – factory expenses, administrative expenses.	
1.5	Wage and incentive plans (fixed, piece rate with guranteed base, straight piece rate, differential piece rate).	
2.0	ESTIMATION OF WEIGHTS AND MATERIALS	4
2.1	Forms of materials: casting, forgings, bar or billets; different cross-section.	
2.2	Procedural steps for calculating material cost of a product.	
2.3	Centroids and areas of plane figures, volumes and surface areas of solids	
3.0	ESTIMATION IN MACHINE SHOP	4
3.1	Time considerations during machining: job set up, tool set up, inspection of job, fatigue allowance.	
3.2	Terms related to machining: cutting speed, feed, depth of cut.	
3.3	Lathe operations: turning, knurling, facing, drilling, boring, reaming, threading, tapping.	
3.4	Milling operations: Cutting operation, facing operation.	
3.5	Grinding operations: surface grinding, cylindrical grinding.	
3.6	Shaping and planning: shaping operation, planning operation.	
4.0	ESTIMATION IN SHEET METAL SHOP	4
4.1	Common operations and processes in sheet metal shop.	
4.2	Common sheet metal joints.	
4.3	Calculation of blank size, blank layouts, estimation of time in different processes and capacity of press for sheet metal work.	

4.4 Practice exercise: window frame, funnel, open and covered tanks, cylindrical tank, tables, racks, mould box, chimney etc.(any five).

5.0 ESTIMATION IN FORGING SHOP 4

5.1 Common forging operations.

5.2 Estimation of net weight, and estimation of losses: long loss, scale loss, sprue loss

5.3 Estimation of time: heating the job, performing forging operation.

6.0 ESTIMATION IN WELDING SHOP 5

6.1 Estimation of welding cost: preparation cost, cost of material, labour cost, finishing cost, on cost

6.2 Estimation of gas cutting cost: cutting cost, finishing cost, on cost

6.3 Estimation of electric welding cost: Material cost, labour cost, power charges, Finishing cost, on-cost.

7.0 ESTIMATION IN PATTERN MAKING AND FOUNDRY SHOP 5

7.1 Estimation of pattern cost: direct material cost, direct labour cost, overheads.

7.2 Estimation of foundry shop: material cost, labour cost, on-cost

8.0 PRACTICE EXERCISE: 30

Estimation of the following items using the procedures related to different shops.

a) Stools, book case, chest drawers, packing box, surface plate, face plate, pulley bracket, stepped pulley, foot step bearing block (any four).

b) Bracket, flanged coupling, pulley, cone clutch, piston, flanged bush bearing, air valve, crank shaft, piston rod (any five)

Total Hrs 60

REFERENCE BOOKS:

1. D. Kannappan, A.G. Augustine and D. Paranthaman : *Mechanical Estimating and Costing* - Tata Mc-graw Hill Publishing Co. Ltd., New Delhi.
2. T. R. Banga and S.C. Sharma: *Mechanical Estimating and Costing* - Khanna Publishers, Delhi.
3. J. S. Charaya and G. S. Narang : *A Text Book of Estimating and Costing (Mechanical)*.
4. C. K. Singh and M. I. Khan: *Mechanical Costing & Estimation* - Standard Publishers Distributors, Delhi – 6.
5. O. P. Khanna : *A Text Book of Mechanical Estimating and Costing* - Dhanpat Rai & Sons
6. S. C. Jain : *Mechanical Estimating and Costing* - Dhanpat Rai & Sons
7. T. P. Mukherjee and P. G. Goswami : *Estimating and Costing* - M. Datta & Co., Calcutta
8. B. P. Sinha: *Mechanical Estimating and Costing* – Tata Mc Graw Hill Publishing Company Limited, New Delhi.

PROFESSIONAL PRACTICE V

L T P
0 0 6

Curri. Ref.No: ME515

Total Contact hrs.: 90

Total marks: 50

Practical:

Theory: 0

P.A : 50

Practical: 90

Credit: 3

Aim:-

To develop general confidence, ability to communicate and attitude, in addition to basic technological concepts through Industrial visits, expert lectures, seminars on technical topics and group discussion.

Objective:-

Student will be able to:

- Acquire information from different sources.
- Prepare notes for given topic.
- Present given topic in a seminar.
- Interact with peers to share thoughts.
- Prepare a report on industrial visit, expert lecture.

Pre-Requisite:- Nil

Activities

1. INDUSTRIAL VISITS

16

Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the term work.

Two industrial visits may be arranged in the following areas / industries to observe - Material Handling System, quality control charts / production record / layout flow systems / Facilities / Hydraulic & pneumatic systems / Working of Boilers and steam engineering applications.

- i) Auto / Electronic equipment manufacturing industry.
- ii) Cement / Sugar / Chemical / Textile / Steel rolling mills / extrusion industries.
- iii) Material handling in mines or ports.
- iv) Earth Moving Equipment Maintenance Shop.

2. THE GUEST LECTURE (S)

20

Lectures by Professional / Industrial Expert be organized from any of the following areas (four lectures of two hour duration) student shall submit the report on each lecture:

- a) Battery and its charging system
- b) Electronic ignition system
- c) Micro-processor based instrumentation in Automobiles
- d) Earth moving machines.
- e) Tractors
- f) Excavators.
- g) Fork lift truck.
- h) Road- roller.
- i) Automated Guided Vehicles (AGV)
- j) Career opportunities in Service stations, Marketing, Surveyor, Insurance, R&D, call centers, CAD, NDT, Railways, Defense, Aeronautics, Marine, Software development, Information Technology
- k) Continuing education / Open university Programs,
- l) Air compressor technology
- 2) Tribological Aspects in automobiles / machine tools

3. GROUP DISCUSSION: (TWO TOPICS)

20

The students shall discuss in group of six to eight students and write a brief report on the same as a part of term work. The topic for group discussions may be selected by the faculty members. Some of the suggested topics are:

- i. Solar Vehicles / Electric Vehicles.
- ii. Auto Vehicles - Comparison.
- iii. Two stroke versus four stroke engines
- iv. Recycling of plastics and other waste material
- v. Attributes of product design
- vi. Creativity and innovativeness
- vii. Energy conservation in institutes
- viii. Value engineering
- ix. Revolution in communication technology
- x. Pneumatic tools and equipments

4. STUDENT ACTIVITIES:

10

The students in a group of 3 to 4 will perform ANY THREE of the following activities (other similar activities to be considered), and write a report as a part of term work.

ACTIVITY:

- i. Collecting internal communication forms.
- ii. Collecting Failure data for automobile / machines / equipments.
- iii. Study of Hydraulic system for any one application like - dumpers, Earth moving equipment, Auto service station.
- iv. Survey of oils used for hydraulic circuits - specifications, properties, costs, manufacturers names etc.
- v. Study any one type of CNC machining center and prepare report on tooling and tool holding devices
- vi. Using finite element method analyse stresses in a cantilever beam. Write all the steps involved with brief description.
- vii. For a given job write a sequence of operations performed by automated manufacturing system. Draw a block diagram of control system to perform above operations
- viii. Survey of types of bearings involving information about construction working principles, mounting, lubrication, materials, advantages, limitations and cost.
- ix. Prepare a trouble shooting chart for any refrigeration system and suggest remedial measures to avoid failures
- x. For a drilling or milling operations on a simple machine component, draw a jig or fixtures showing various features like locating clamping, fool proofing etc.
- xi. Compare non-traditional methods on the basis of working principles, accuracy, MRR, Applications and limitations a) EBM b) PAM c) AJM d) WJM
- xii. For a given job involving 3 to 4 operations suggest to prepare a report

5. SEMINAR:-

24

Seminar on any advanced technical topic to be presented by individual student in a batch of 20 students. A separate topic be selected by an individual student.